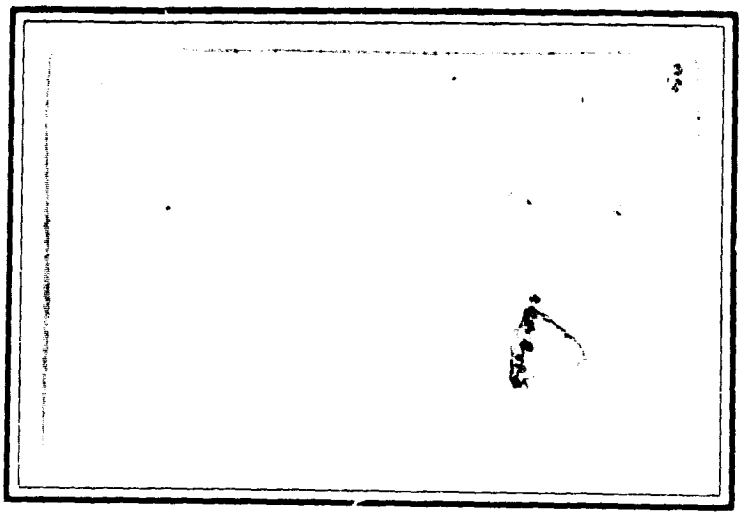

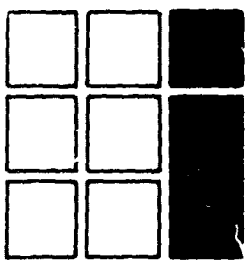

INTERMETRICS

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PDSS/IMC
CIS USERS GUIDE

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George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Prepared By: Intermetrics, Inc.
3322 South Memorial Parkway
Huntsville, Alabama 35801
(205) 883-6860

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PREFACE

This document contains the PDSS/IMC Computer Interface Simulation (CIS) user's manual.

This document was prepared for the Information and Electronic Systems Laboratory of the Marshall Space Flight Center under NASA contract NAS8-33825.

Technical direction was provided by:

Mr. Jim Lewis (EB32)
Mr. Bob Panciera (EB32)
Mr. Ken Williamson (EB42)

Questions concerning this document should be directed to the Intermetrics, Inc., Huntsville office.

Intermetrics, Inc.
3322 South Memorial Parkway
Century Office Center, Suite 72
Huntsville, Alabama 35801
(205) 883-6860

Approved
By: J. R. Bounds
J. R. Bounds
Director
Southeast Division

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ACRONYMS

AI	Analog Input
AO	Analog Output
AST	Astros Start Tracker
ASTROS	Advanced Star/Target Reference Optical Sensor
CCD	Charged Coupled Device
CDMS	Command and Data Management System
CIS	Computer Interface Simulation
CPD	Cruciform Power Distributor
DEP	Dedicated Experiment Processor
DI	Discrete Input
DO	Discrete Output
DRIRU	Dry Rotor Inertial Reference Unit
ECAS	Experiment Computer Application Software
ECIO	Experiment Computer Input/Output
ECOS	Experiment Computer Operating System
EIMC	Electrical Interface Mode Commands
ESA	European Space Agency
FI	Flexible Input
GML	General Measurement Loop
GMT	Greenwich Mean Time
GSE	Ground Support Equipment
HRM	High Rate Multiplexor
HUT	Hopkins Ultraviolet Telescope
IIA	Instrument Interface Agreement
IMC	Image Motion Compensator
IMCE	Image Motion Compensation Electronics
IMCS	Image Motion Compensation Subsystem
IPS	Instrument Pointing System
LAM	Look At Me
MMU	Mass Memory Unit
NASA	National Aeronautics and Space Administration
PCC	Programmable Crate Controller
PCM	Pulse Code Modulated
pid	Page Identifier
PDSS	Payload Development Support System
POCC	Payload Operations Control Center
QT	Qualification Test
RAU	Remote Acquisition Unit
RAUI	Remote Access Unit Interface
RAUS	Remote Access Unit Simulator
RFC	Reflight Certification
RIUI	Remote Interface Unit Interface
SEID	Spacelab Experiment Interface Device
SI	Serial Input
sid	Signal Identifier
SL	Spacelab
SO	Serial Output

ACRONYMS
(CONTINUED)

SPL	Scratch Pad Line
SPSME	Spacelab Payload Standard Modular Electronics
SRR	Software Requirements Review
SWCDR	Software Critical Design Review
SWCI	Software Configuration Inspection
SWPDR	Software Preliminary Design Review
UV	Ultraviolet
UIT	Ultraviolet Imaging Telescope
UTC	User Time Clock
WUPPE	Wisconsin Ultraviolet Photopolarometry Experiment

CIS USERS GUIDE

1.0 INTRODUCTION

The PDSS/IMC Computer Interface Simulation (CIS) software was developed in accordance with the following document:

PDSS/IMC Requirements and Functional Specifications
IR-AL-010
Revision 1.1
15 August 1984

The PDSS/IMC CIS software executes as an application of PDSS. The user should reference the following documents for details on the operation of the PDSS/SEID.

PDSS User's Manual
IR-AL-001
Revision 2.1
Intermetrics, Inc.
15 July 1984

SEID II Specifications
IR-AL-007
Revision 1.0
Intermetrics, Inc.
15 July 1984

The user should also be familiar with the DEC RT-11 Operating System, the DEC LSI 11/23 processor, and the Standard Engineering CAMAC Crate. Figures A-1, A-2, and A-3 show the PDSS configuration for the CIS application.

Figures A-7 to A-12 define the PDSS/IMC display pages supported for the CIS application. Figure A-7 is the standard PDSS display page containing data and status for the SEID interfaces. Figure A-9 is the simulated display page for the ASTRO/IMCE flight display page. Figures A-8 to A-12 are the user defined display pages.

2.0 PDSS/IMC CIS STRUCTURE

The PDSS/IMC CIS software provides a real time interface simulation for the following IMC subsystems:

- Dry Rotor Inertial Reference Unit (DRIRU-II)
- Advanced Star/Target Reference Optical Sensor (ASTROS)
- Ultra Violet Imaging Telescope (UIT)
- Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE)
- Cruciform Power Distributor (CPD)
- Spacelab Experiment Computer Operating System (SL-ECOS)

The CIS models are structured as PDSS tasks allowing the models to be active/inactive as specified by tne operator. Figure A-4 depicts the task (Model) data flow for the CIS application.

Figure A-5 defines the CIS model interfaces and Figure A-6 specifies the interface assignments to the models.

A brief description of each of the models follows.

2.0.1 POWER SUBSYSTEM MODEL

The Power Subsystem model runs once per second. The model acquires four power signals over SEID FI channels (FI 33 = +5V, FI 37 = +15V, FI 39 = -15V, and FI 45 = temp). The model outputs to the CAMAC AO's either the acquired signals or data values DPWR. Figure 2-1 defines the power subsystem model logic.

2.0.2 UIT INTERFACE MODEL

The UIT interface model receives two serial messages and outputs pitch and yaw analog differences every 20 milliseconds. Figure 2-2 depicts the UIT interface model.

2.0.3 WUPPE INTERFACE MODEL

The WUPPE interface model receives one serial message every 20 milliseconds. Figure 2-3 depicts the WUPPE interface model.

2.0.4 DRIRU MODEL

The DRIRU model provides a DRIRU-II interface simulation that includes 12 incremental angle pulse channels, 12 range status telemetry discrete output channels, 6 analog rate telemetry analog output channels, 3 gyro temperature resistor channels, 3 motor current telemetry analog output channels, and 12 electrical interface mode command discrete input channels. Figure 2-4 depicts the DRIRU model.

2.0.5 AST MODEL

The AST model provides an interface simulation for the AST Star Tracker. Figure 2-5 depicts the AST Interface Signals and Figure 2-6 depicts the AST model logic.

2.0.6 COMET TRACK MODEL

The Comet Track model provides a data interface simulation of the Comet Track data. Figure 2-7 depicts the Comet Track model.

2.0.7 ECOS/ECAS MODEL

The ECOS/ECAS models provide a simulation of the ASTROS ECOS and ECAS functions including DDU flight display, DDU keyboard processing, exception monitoring, and ECIO data acquisition.

INPUT	PROCESS	OUPUT
	REPEAT EVERY 1.0 SECOND	
ACQUIRE POWER SIGNALS	CASE DCTRL[1]	
FI 33=+5V	0: SELECT FI VALUES	
FI 37=+15V		
FI 39=-15V	>0: SELECT DPWR VALUES	
FI 45=TEMP	<0: SELECT NO OUTPUT	
	ENDCASE	
	OUTPUT POWER SIGNALS	CAMAC AO
	END REPEAT	N(11)A(0) = +5V VALUE N(11)A(1) = +15V VALUE N(11)A(2) = -15V VALUE N(11)A(3) = TEMP VALUE

FIGURE 2-1: POWER SUBSYSTEM MODEL

INPUT	PROCESS	OUTPUT
	REPEAT EVERY 20 MILLISECONDS	
ACQUIRE UIT SERIAL MESSAGE	FETCH UIT PITCH AND YAW DATA	
UITI SERIAL	OUTPUT UIT PITCH AND YAW ANALOG	
	END REPEAT	CAMAC AO N(10)A(6) = UIT XERR N(10)A(7) = UIT YERR

FIGURE 2-2: UIT INTERFACE MODEL

INPUT	PROCESS	OUTPUT
	REPEAT EVERY 20 MILLISECONDS	
ACQUIRE WUPPE SERIAL MESSAGE		
WUPPE SERIAL	FETCH WUPPE PITCH AND YAW	
	END REPEAT	

FIGURE 2-3: WUPPE INTERFACE MODEL

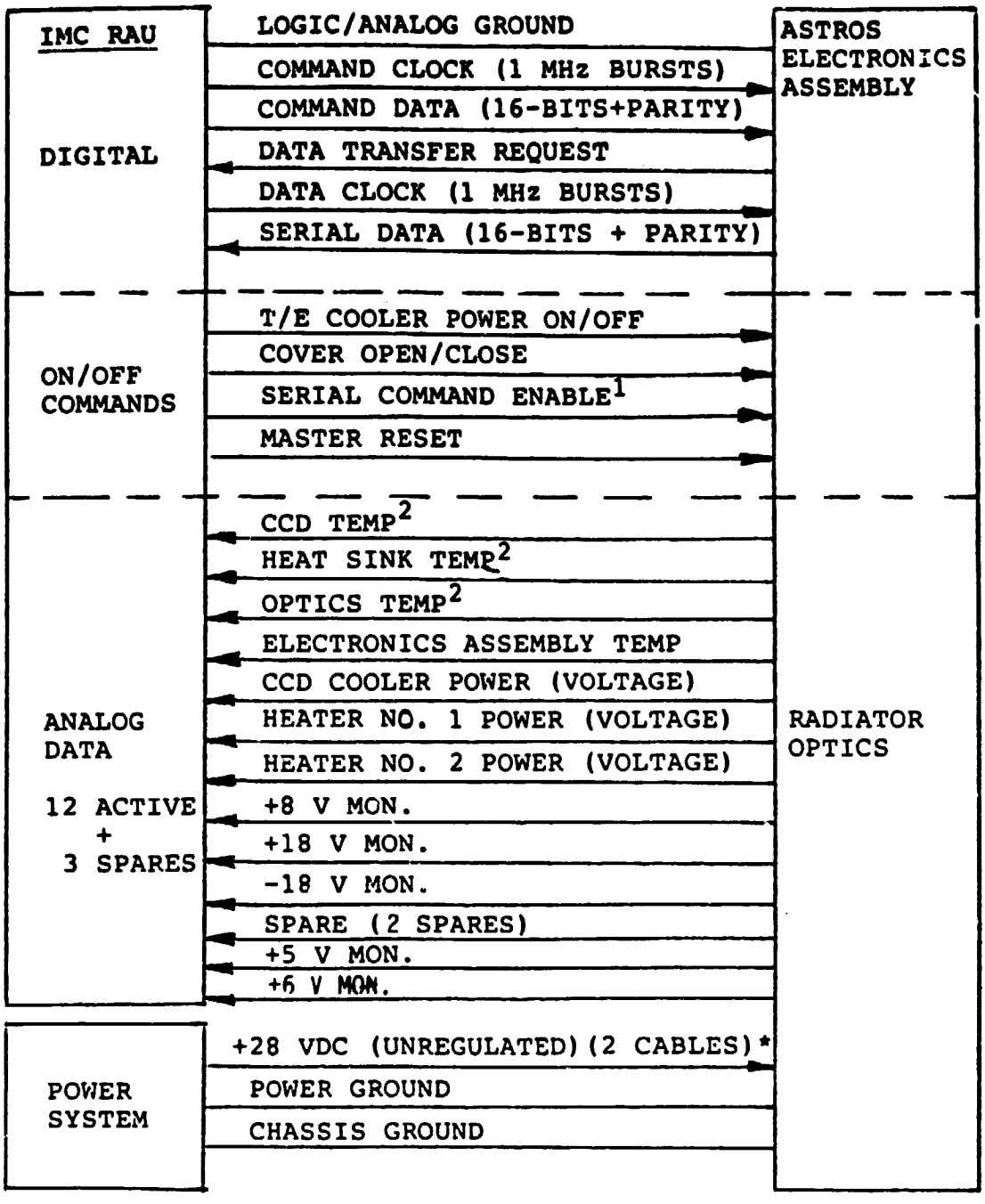
INPUT	PROCESS	OUTPUT
	REPEAT EVERY 1 SECOND	
ACQUIRE EIMC		

DISCRETE INPUTS
RRH1A=FI1
RRH2A=FI2
RRL1A=FI5
RRL2A=FI7
RRH1B=FI9
RRH2B=FI11
RRL1B=FI13
RRL2B=FI15
RRH1C=FI17
RRH2C=FI19
RRH1C=FI21
RRL2C=FI23
	FETCH EIMC DISCRETE INPUTS
	
	IF DRIRU INITIALIZE
	
	SELECT MOTOR CURRENT DATA DTMV
	
	SEND MOTOR CURRENT DATA
	
	ENDIF
	BEGIN RANGE STATUS TELEMETRY
	COMPUTATION
	IF (RRH1x .AND. RRH2x)=1
	THEN RSTxxx=0
	IF (RRL1x .AND. RRL2x)=1
	THEN RSTxxx=1
	CASE DCTRL [8]
	0: SELECT MODEL RST DATA
	>0: SELECT DRST
	<0: SELECT NO OUTPUT
	END CASE
	SEND RST DATA
	END BEGIN
		CAMAC AO
		
		N(11)A(4)=T/MA
		N(11)A(5)=T/MB
		N(11)A(6)=T/MC
		
		SEID DO
		RSTX1A=DO#16
		RSTX1B=DO#17
		RSTY1B=DO#18
		RSTY1C=DO#19
		RSTZ1A=DO#20
		RSTZ1C=DO#21

FIGURE 2-4: DRIRU MODEL

INPUT	PROCESS	OUTPUT
	IF PULSE OUTPUT COMPLETE SELECT GYRO DATA DGYRO SELECT GYRO DATA DRATE SEND GYRO DATA	GYROSI DTXA=N(6)A(0) DTXB=N(8)A(0) DTYB=N(7)A(0) DTYC=N(7)A(1) DTZA=N(6)A(1) DTZC=N(8)A(1)
	COMPUTE ANALOG RATE TELEMETRY SEND ANALOG RATE TELEMETRY END REPEAT	CAMAC A0 N(12)A(2)=ANRXA N(12)A(3)=ANRXB N(12)A(4)=ANRYB N(12)A(5)=ANRYC N(12)A(6)=ANRZA N(12)A(7)=ANRZC

FIGURE 2-4: DRIRU MODEL
(CONTINUED)



*1 POWER CABLE TO ELECTRONICS AND 1 POWER CABLE TO HEATERS.

NOTE 1 - MSFC MENTIONED REMOVAL OF THIS LINE.

NOTE 2 - SCALE FACTORS DEFINED IN DETAILED SPEC #ES513218.

FIGURE 2-5: ASTROS INTERFACE SIGNALS

INPUT	PROCESS	OUTPUT
ACQUIRE AST SERIAL ASTI (2 WORDS)	REPEAT EVERY 1.0 SECOND SELECT AST ANALOG DATA -DASTAL SEND AST ANALOG DATA FETCH AST SERIAL INPUT CASE SERIAL INPUT COMMAND: PROCESS COMMAND FRAME START: SELECT OUTPUT DUMP: SELECT DUMP END CASE SEND AST SERIAL OUTPUT END REPEAT	CAMAC F0 N(9)A(0)= CCD TEMP 1 = HEAT SINK TEMP 2 = OPTICS TEMP 3 = EA TEMP 4 = CCD LOOP PWR 5 = HEAT #1 PWR 6 = HEAT #2 PWR 7 = HEAT #3 PWR N(10)A(0)= +5V 1 = +8V 2 = +18V 3 = -19V 4 = SA ELECTRONICS 5 = BASE PLATE TEMP ASTI SERIAL OUTPUT (10 WORDS)

FIGURE 2-6: AST MODEL

INPUT	PROCESS	OUTPUT
	REPEAT EVERY 100 MILLISECONDS	
	SELECT COMET TRACK DATA - DTRACK	
	SEND COMET TRACK DATA	WRITE SEID PCM CHANNEL #0 9 WORDS TRACK DATA
	END REPEAT	

FIGURE 2-7: COMET TRACK MODEL

2.1 PDSS POWER UP

The following steps should be followed to power up PDSS.

STEP	ACTION
1	Turn Conrac VDU Power Switch On
2	Turn DSD-880 Power Switch On
3	Turn VT-125 Power Switch On
4	Turn Quantex Line Printer Switch On
5	Turn PDSS Crate Power Switch On
6	Turn SEID Power Switch On

The LSI 11/23 will boot RT-11 from the DSD winchester disk. Standard RT-11 operating system commands can be used for setting date and time.

```
DATE  dd-mm-yy
TIME  hh:mm:ss
```

The RT-11 initialization file "SY:STARTX.COM" sets the date. The DATE command in this file can be changed using standard DEC editor functions.

The SEID time is set by the "SET-GMT" command as described in IR-AL-007.

2.2 PDSS Power Down

The following steps should be followed to power down PDSS.

STEP	ACTION
1	Turn Conrac VDC Power Switch Off
2	Turn DSD-880 Power Switch Off
3	Turn VT-125 Power Switch Off

4 Turn PDSS Crate Power Switch Off
5 Turn SEID Power Switch Off
6 Turn Quantex Line Printer Switch Off

2.3 PDSS/IMC CIS CABLES

The following cables should be connected.

```
CAMAC RAUI-J1----------------------IMCE ASTI-J1
CAMAC RIUI-J1 (UIT)----------------IMCE DEI-J1
CAMAC RIUI-J2 (WUPPE)--------------IMCE DEI-J2
CAMAC GYROS 1 (N5) J1, J2----------IMCE DEI-J3
      GYROS 2 (N6) - J3
      GYROS 3 (N7) - J4
      GYROS 4 (N8) - J5
CAMAC 3112 (N9) - J1---------------IMCE DEI J1,J2
CAMAC 3112 (N10) - J2
CAMAC 3112 (N11) - J3
CAMAC 3112 (N12)

SEID J1, J5------------------------IMCE DIOI J1
SEID J2, J6------------------------IMCE DIOI J2
SEID J3----------------------------CAMAC GYROS 1
SEID J4, J7------------------------IMCE PWR J2
SEID J9----------------------------IMCE HRMI J1, J2
SEID J10---------------------------IMCE RAUI J1, J3, J4, J5, J6
SEID J17, J18----------------------STAGS J1, J2
SEID J19, J20----------------------ITF HRM J1, J2
SEID J15---------------------------CAMAC PARALLEL PORT
```

2.4 RUNNING CIS

The following section covers the commands to start and stop the CIS application.

2.4.1 CIS Start

The CIS application is initiated by the following operations where "..." denotes keyboard entries.

STEP	ACTION	DESCRIPTION
1	"@RCIS"	RT-11 Program Load
2	SEID reset	Reset SEID (see below)
3	"4"	Selection Option 4
4	" "	Power-On IMCE (see below)
5	"INIT"	Start CIS Application
6	"=RUN 1"	Perform SEID Initialize

(1) The "@RCIS" operation causes the RT-11 operating system to perform command file [RCIS.COM], to load the PDSS/IMC application program, and to initiate program execution. When loaded and started, the PDSS program displays the PDSS Master Display page (Figure A-7) on the VT-125 and opens communication with the SEID on the parallel port. When the PDSS LSI 11/23 has established communication with the SEID, the PDSS Master Display will prompt the user to select the program option.

(2) If the PDSS LSI 11/23 cannot establish communication with the SEID, the operator will be prompted to reset the SEID. The SEID reset prompt is noted by the "RESET SEID" message

on the PDSS Master Display and the ringing of the VT-125 bell. The operator should depress the SEID reset button on the SEID front panel **once.** The PDSS Display page should then return to the "SELECT OPTION" message.

CAUTION: Depressing the SEID reset button when not requested or while the program is being loaded causes the program to crash requiring a hard recovery to be performed.

(3) PDSS option "4" should be selected causing the display page to be cleared and the prompt "?" displayed.

(4) Figure A-13 identifies the commands for the power up/down of IMCE subsystems. Two configurations are supported: first - IMCE is powered via the simulated CPD and the PDSS/SEID is cabled to allow SEID control of IMCE power supply, and second - IMCE is powered via the CPD.

(5) The CIS task are initiated by the "INIT" command.

(6) The "=RUN 1" command causes the executive to perfrom the standard SEID initialize.

```
->SEID BEING LOADED
TVS
SLOAD RFC.S5
DEF 5
GML-RES 3
MLOAD RFC.MON
XSEND
MON
D[1]=.F008
D[1]=.F000
```

```
D[0]=.0001
START 5
PDSS/IMC CIS
```

In general, during this period, the operator should not attempt any keyboard commands.

An "=RUN 2" command would cause the executive to bypass the automatic SEID initialization.

If after the "MON" command is issued there are "BAD SEID RESPONSE" messages, the IMCE has not been powered or the RAUI cable has not been connected. The operator should issue a "MOFF". Once the IMCE is powered and the RAUI cabled, the operator enters a "MON" command to start the SEID monitor.

2.4.2 CIS STOP

To stop the CIS task, the following commands should be entered:

```
=STOP
```

The =STOP command causes the following PDSS/IMC commands to be performed.

```
STOP 5
MOFF
QUIT
```

2.4.3 CIS QUICK START/STOP

To perform a quick stop of CIS:

STOP 5
MOFF
PULSE 33,ON or PULSE 54,ON

To perform a quick start of CIS:

PULSE 32,ON or PULSE 56,ON
MON
START 5

2.4.4 CIS FAILURES

During the power on/off sequence, if any of the following conditions arise, a recovery procedure should be used.

1. SEID will not initialize
2. Garbage characters appear on CRT
3. Program does not complete initialization

FAST RECOVERY PROCEDURE:

1. **Reset CRT (Depress SET-UP,0)**
2. **Depress SEID Reset**
3. **Depress LSI 11/23 BOOT**

HARD RECOVERY PROCEDURE:

1. **Power Off SEID**
2. **Power Off PDSS CRATE**
3. **Reset CRT (Depress SET-UP,0)**
4. **Power On PDSS Crate**
5. **Power On SEID**

2.5 PDSS/IMC CIS COMMANDS

PDSS/IMC CIS commands are grouped into two categories: CIS UDU simulated commands and CIS system commands. Figure A-14 lists the commands for each category.

The general syntax for PDSS/IMC commands is as follows:

=cccc</k> <p1,p2,...pn>

All PDSS/IMC commands must have an equal "=" character as tne first character. The "=" character is used by the PDSS keyboard monitor for detecting those commands to be handled by user tasks. Failure to have an "=" as the first character results in a PDSS message - "PDSS-68: INVALID COMMAND".

Embedded blanks are not allowed in the 'cccc'.

The < > brackets denote optional data for commands.

Keys (/k) are optional and may be included with commands.

Parameter data is entered as p1,p2,...pn. Unless otherwise specified, the data is entered in hexadecimal. Leading zeroes

are not required. Spaces are allowed between parameters but not within the data itself. Either commas or spaces may be used as separators. The number of parameters is a function of the command.

2.5.1 DDU SIMULATED COMMANDS

The DDU commands provide a simulated DDU keyboard function.

2.5.1.1 I-Item Entry

Syntax: =I item-number hex-data ...

The =I simulates the DDU Item Entry keyboard function.

Item Entries identified for IMCS are defined in Figure A-15 and Figure A-29.

The IMCS flight display page can be viewed on the PDSS VDU display page 1 (=DISP 1).

2.5.1.2 P-PFK

Syntax: =P pkf-number

The =P simulates the DDU PFK keyboard function. No PFK commands are identified for IMCS. The =P is null processed.

2.5.1.3 T-TYPE

Syntax: =T hex-data

The =T simulates the DDU TYPE keyboard function. No TYPE commands are identified for IMCS. The =T is null processed.

2.5.1.4 C-CMD

Syntax: =C C-type sid hex-data
=C WRI sid hex-data (Figure A-29)
=C ISS sid (Figure A-28)

The =C simulates the DDU CMD keyboard function. CMD sid's are identified in Figures A-30 and A-31. These commands are distinguished by commands that pulse discretes ("ISS") and commands that write serial commands to the AST ("WRI").

Example:

To select GYRO channels XA,YB,ZA the operator enters:
=C ISS 3917 <CR>

Example:

To add defect coordinates C=10, L=14 the operator enters:
=C WRI tbd-sid F002 0A0E <CR>

Example:

To send an AST test command, the operator enters:
=C WRI tbd-sid F003 dddd dddd <CR>

The test commands are summarized in "Software Requirements Definition for ASTROS Star Tracker (AST) Firmware (DM05, Rev. C), 1 June 1984, Jet Propulsion Laboratory, Figure A-42.

2.5.2 SYSTEM COMMANDS

The System commands identified in Figure A-14 provide operator control of system functions. Each command is described in the following sections.

2.5.2.1 COMM Command

Syntax: =COMM comment-character-string
comment-character-string = character string of length 16

The COMM command allows the operator to enter a 16 character comment line in the log buffer. On each log cycle, the entire log buffer including the comment field is written to disk.

The COMM command can be used for reference points, reminders, or test headers.

2.5.2.2 CTRL Command

Syntax: **=CRTL control-key [,integer-data]**
control-key =["/V", "/M", "/E", "/T"]

The CTRL command provides system level control to the operator.

/V

The "/V" key toggles the verify control switch between verify/no-verify.

/M

The "/M" key toggles the mode control switch.

/T

Syntax: **/T i,t**

where **1 <= i <= 28**
t = milliseconds

The "/T" key causes time parameter i to be updated to time value t (milliseconds). PDSS/IMC software provides the user with setable time variables as listed in Figure A-16.

/E

Syntax: /E i

where i

0 = Reset to zero

1 = Freeze

2 = Compute drift rate

The "/E" command controls the earth's rate computation for DRIRU comparison.

The earth's drift rate is computed as 15.04107 arc-seconds/second * cos (Latitude = 34.6474) (15.04107 * COS(346474) = 12.373781) and is displayed on display page 3 (=DISP 3). The gyro drift rates are read and accumulated once per second.

2.5.2.3 DISP Command

Syntax: =DISP display-key pid

display-key = ["/I", "/F", "/U"]

The DISP command is used to request the active display of a display page, to re-initialize a display page, to freeze a display page, or to unfreeze a display page.

Unless frozen, all display pages are updated on a round robin basis at the display rate.

The pid parameter designates the display page (i.e.,1 $\leq$ pid $\leq$ 5). A value for pid outside this range is treated as an invalid parameter and the command is not processed.

Example:

=DISP 2

Requests an active display of page 2. The requested page is mapped to the active page of the VDU.

Example:

=DISP/I 3

Re-initializes the background data from disk for page 3. The foreground or variable data for page 3 will be lost.

Example:

=DISP/F 1

Freezes display page 1. The display function will not update the page data until an unfreeze is invoked.

Example:

=DISP/U 1

Unfreezes display page 1.

2.5.2.4 LOG Command

Syntax: =LOG [addr,number-words]

The =LOG command toggles the PDSS/IMC log control switch between active/inactive. When active, the PDSS/IMC log function

logs the IMC Data Buffers to disk file (IMC.LOG) at the time interval [T26=1.0 seconds]. When inactive, the PDSS log function is not performed.

If no parameters are specified, the log function defaults to addr(GMT),852; i.e., the log record is 852 words in length and starts at the data entry GMT.

2.5.2.5 MOD Command

Syntax: =MOD addr hex-data ... hex-data
addr = octal address
hexdata = hexadecimal data

The MOD command is used to change data. The hexadecimal data is moved into the data buffer beginning at the address (addr) specified. If the address range is actively being displayed on the VIEW page, the display data will be updated.

After all data has been deposited in memory, the next deposit address is displayed on the system console.

2.5.2.6 PMEM Command

Syntax: =PMEM

The PMEM command prints the display pages on the PDSS line printer. This command provides a hard copy mechanism for saving the display pages during testing. All display pages are printed.

2.5.2.7 STOP Command

Syntax: =STOP

The STOP command closes the log file, stops the logging function, and clears the CAMAC CSR, INT and CCR registers. The command stops the comet track seqeunce ("STOP 5") and stops the SEID monitor ("MOFF"). The STOP command should be used just prior to terminating a session.

2.5.2.8 VIEW Command

Syntax: =VIEW[view-key][addr]
addr = octal address

The VIEW command causes the PDSS/IMC Data or the SEID Data Buffers to be displayed to the VDU. The data is displayed as 4 hex characters (16 bits).

The /S control key causes the SEID Data Buffer area to be displayed. If the /S control key and the adr parameters are absent, the VIEW defaults to the ABEGIN area.

The VIEW display page is displayed to the VDU when the =VIEW command is entered. The data on the display is refreshed at a 1.0 second display refresh rate.

2.5.2.9 TASK Command

Syntax: =TASK task-mask

The TASK command allows the operator to engage or disengage the application tasks. The tasks are selected by the task-mask parameter which is described in Figure A-16.

2.5.2.10 DATA COMMAND

Syntax: =DATA data-index data-code hex-data

The DATA command allows the operator to modify model data. The DATA data table is depicted in Figure A-17. The data index parameter references the model data control indes. The data-code parameter sets the model data control code. The data-code values are:

Code Value	Source of Output Data
0	Model
>0	Table
<0	No Output

The association for the model data and the output data is shown in Figure A-18.

2.5.2.11 TMC COMMAND

Syntax: =TMC RUN filename
=TMC STOP
=TMC HOLD
=TMC GO

The TMC file is created by the user using standard DEC editor. The file consists of statements of which the first character defines the statement type.

FIRST CHARACTER	STATEMENT TYPE
.	Stop (EOF) for TMC file
*	wait time tttttt = time in milliseconds
$	comment line
=	PDSS/IMC keyboard command
else	PDSS command

The =TMC RUN initiates the TMC statement processing defined by file = "filename". The statements are processed sequentially until the stop statement is encountered.

The =TMC STOP stops the TMC statement processing immediately.

The =TMC HOLD freezes the TMC statement processing until a go command is received.

The =TMC GO releases the TMC statement processing.

2.5.2.12 WAO COMMAND

Syntax: =WAO WAO-index hex-data

The WAO command allows the operator to output a data value to a CAMAC AO register. Figure A-19 lists the CAMAC IO indices and their assigned functions. Figure A-38 shows typical CAMAC AO voltage conversions from hexadecimal data.

The user should be aware that the analog output value will be over-written by the models unless an =DATA command has been previously entered to freeze data.

2.5.2.13 RUN COMMAND

Syntax: =RUN run-code
run-code = 1 initialize SEID
2 skip initialize

The =RUN provides the operator the capability to skip the standard SEID initialize.

2.6 MESSAGES

The following messages are displayed to the PDSS system console. An explanation of each message is given.

MSG#	MESSAGE
1	-> ERR PARMS The command syntax is incorrect, a parameter value is invalid, or the number of parameters is incorrect.

2 -> ERR COMMAND
The command is invalid and is not processed.

3 -> ERR MAP EXTENDED MEM
The RT-11 system calls to establish Extended Memory Mapping indicates an error. This is an RT-11 or hardware error. PDSS/IMC will not run without Extended Memory Mapping.

4 -> ERR LOOKUP
A system LOOKUP for a data file was in error.

5 -> ERR READ
Disk read error occurred.

13 -> ERR LOOKUP MMU.IMC
System LOOKUP of file MMU.IMC resulted in error.

14 -> ERR LOOKUP IMC.LOG
The IMC log file (IMC.LOG) could not be opened.

15 -> ERR LOG FULL
The IMC log file (IMC.LOG) is full and has been closed.

17 -> ERR PMEM LP
An error was encountered in writing to the line printer. Verify that the printer is on.

18 -> ERR WSSER
An error occurred on the .WRITE to SEID.

19 -> SEID BEING INITIALIZED
SEID being loaded by PDSS.

20 -> TMC HOLD
TMC is in HOLD state.

21 -> TMC STOP
TMC has been stopped.

22 -> ERR AST CMD
An invalid AST command was received.

2.7 PDSS/IMC GENERATION

The PDSS/IMC files are as follows.

FILE	CONTENTS
PDSSFG.SAV	PDSS Foreground Task
IMCCIS.MAC	CIS Source Code
IMCCIS.OBJ	CIS Object Code
IMCCIS.SAV	CIS LOAD
RFC.MON	CIS SEID Montor File
D.001	CIS Display Page 1 Background
D.002	CIS Display Page 2 Background
D.013	CIS Display Page 3 Background
D.004	CIS Display Page 4 Background
D.012	CIS Display Page 5 Background
IMC.LOG	IMCLOG
RFC.S5	CIS Comet Track Sequence
MMU.IMC	MMU Load File

The RT-11 command to recompile the CIS software is:

MACRO IMCCIS

The RT-11 command to link the CIS software is:

```
@LCIS
```

The contents of the LCIS.COM file is as follows:

```
R LINK
IMCCIS, IMCCIS=PDSS, READKB, USRKB, LOG, INTHEX/C
VRAMC, SEID2, USRDP, USRSQ, USRCIS, IMCCIS//
```

The RT-11 command to run the CIS software is:

```
@RCIS
```

The contents of the RCIS.COM is as follows:

```
RUN ICAMAC
FRUN PDSSFG.SAV
RUN IMCCIS
```

2.8 LOG DUMP

The LDUMP program displays the log on the PDSS CRT.

The operations enumerated below should be followed:

(1) RENAME IMC.LOG ZSEID.LOG
(2) LDUMP
(3) SET-UP 9
    log display
(4) SET-UP 9

The NO-SCROLL key can be used to control the display scroll; i.e., to start and stop the display scrolling.

2.9 IMCE DEP MMU LOAD

The support program BMMU generates the DEP MMU Load file.

INPUT FILE: MMU.MAC

OUTPUT FILES: MMU.IMC
DEP.IMC

The file MMU.MAC contains the data source for the DEP MMU load. This file is edited using the standard RT-11 editor (EDIT MMU.MAC).

After the MMU.MAC file has been edited, the following steps should be followed.

```
1. MACRO MMU.MAC     /* Assemble MMU.MAC */
2. @BMMU             /* Link BMMU & MMU */
3. RUN BMMU          /* Execute BMMU */
```

BMMU expects the PDSS Line Printer to be cabled and powered.

2.10 PATCHING DEP MMU LOAD FILE

The PDSS DEP MMU load file [MMU.IMC] can be patched using the RT-11 PATCH utility. The commands for executing PATCH are

discussed below. Bold letters indicate keyboard entries the user should make.

To call PATCH from the PDSS system console:

```
.R PATCH <RET>
FILENAME--
*MMU.IMC/A
```

To examine and change locations in the file the general format is:

```
*word-offset/ current-value  new-value <RET> or <LF>
```

For example if the first and second words have the values 397.('6.5) and 3.('3), they may be changed to the values by the 1 and 2 following commands:

```
*0/  615  2  <LF>
*2/    3  2  <RET>
```

To exit the PATCH utility, the E command causes PATCH to close the file and return control to RT-11.

```
* E
```

2.11 REALTIME MODIFYING DEP MMU LOAD DATA

The PDSS DEP MMU load can be examined and modified by the following procedure.

=CTRL/M	Sets MMU Load patch mode
=I 3	Causes file to be read
=VIEW 143600	Displays Load data
=MOD address data	Modifies Load data
=I 3	Performs MMU Load to DEP

APPENDIX A

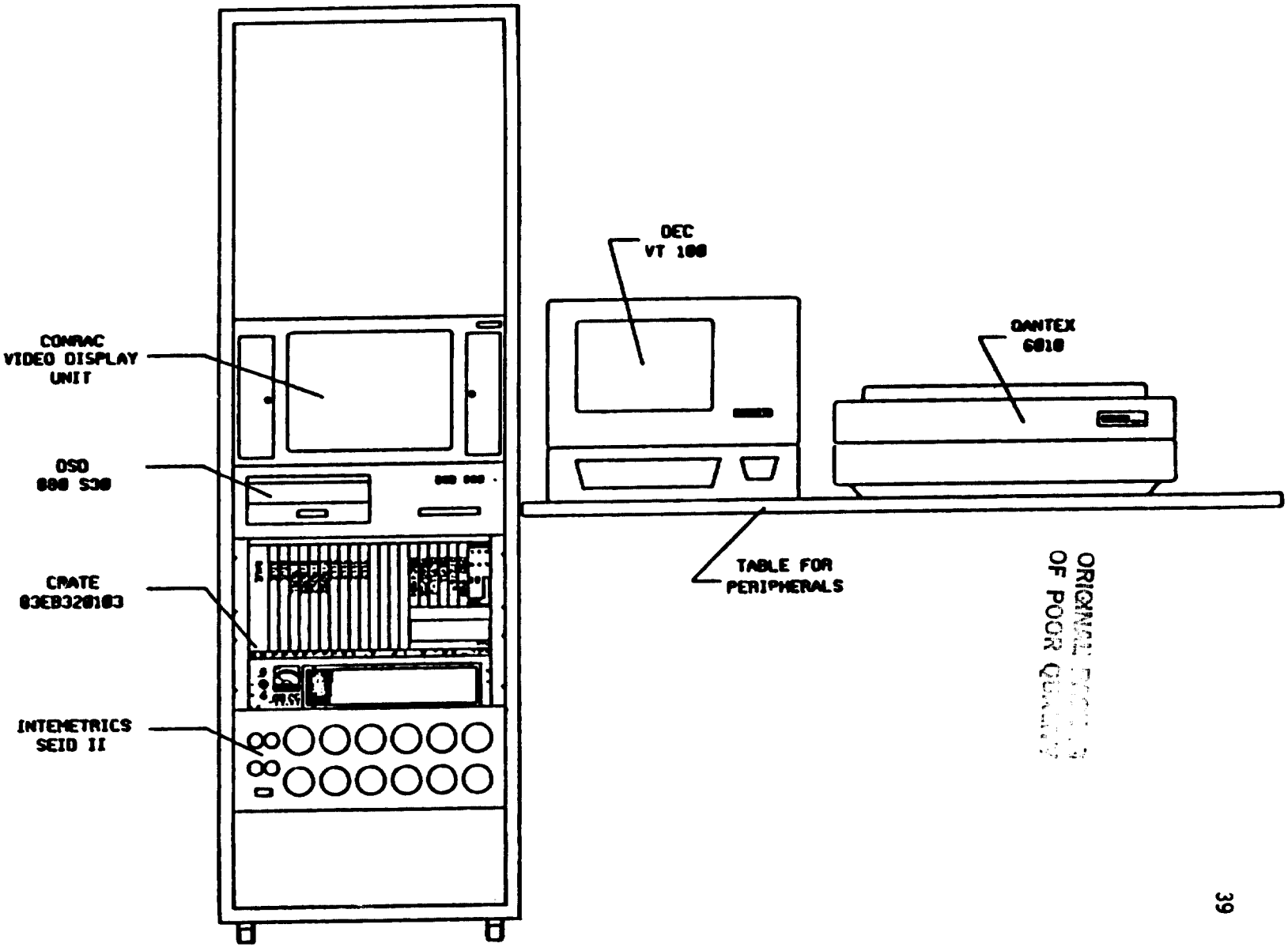


FIGURE A-1: PDSS/IMC GSE LAYOUT

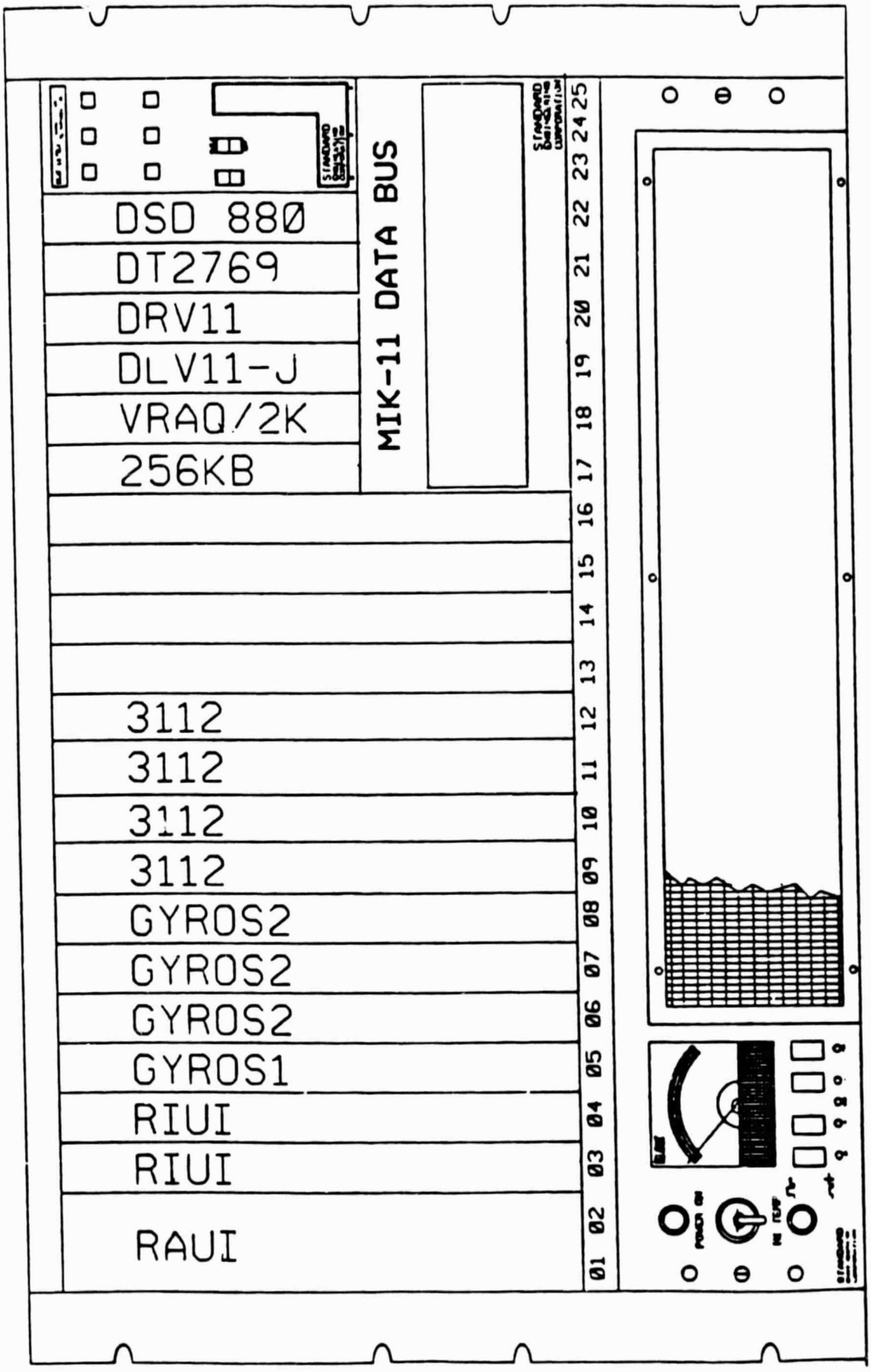


FIGURE A-2: PDSS/IMC CAMAC CRATE

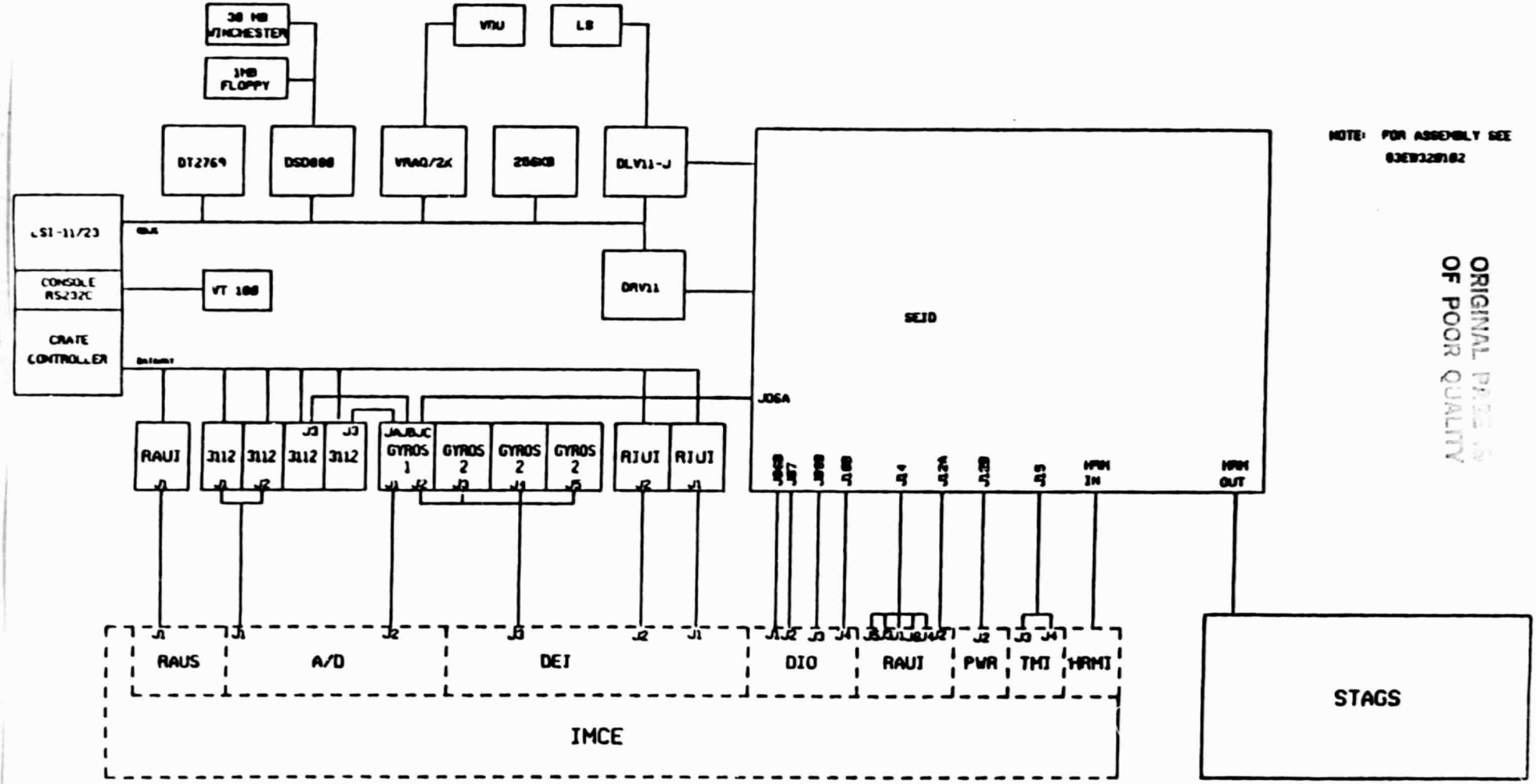


FIGURE A-3: RFC TASK FLOW

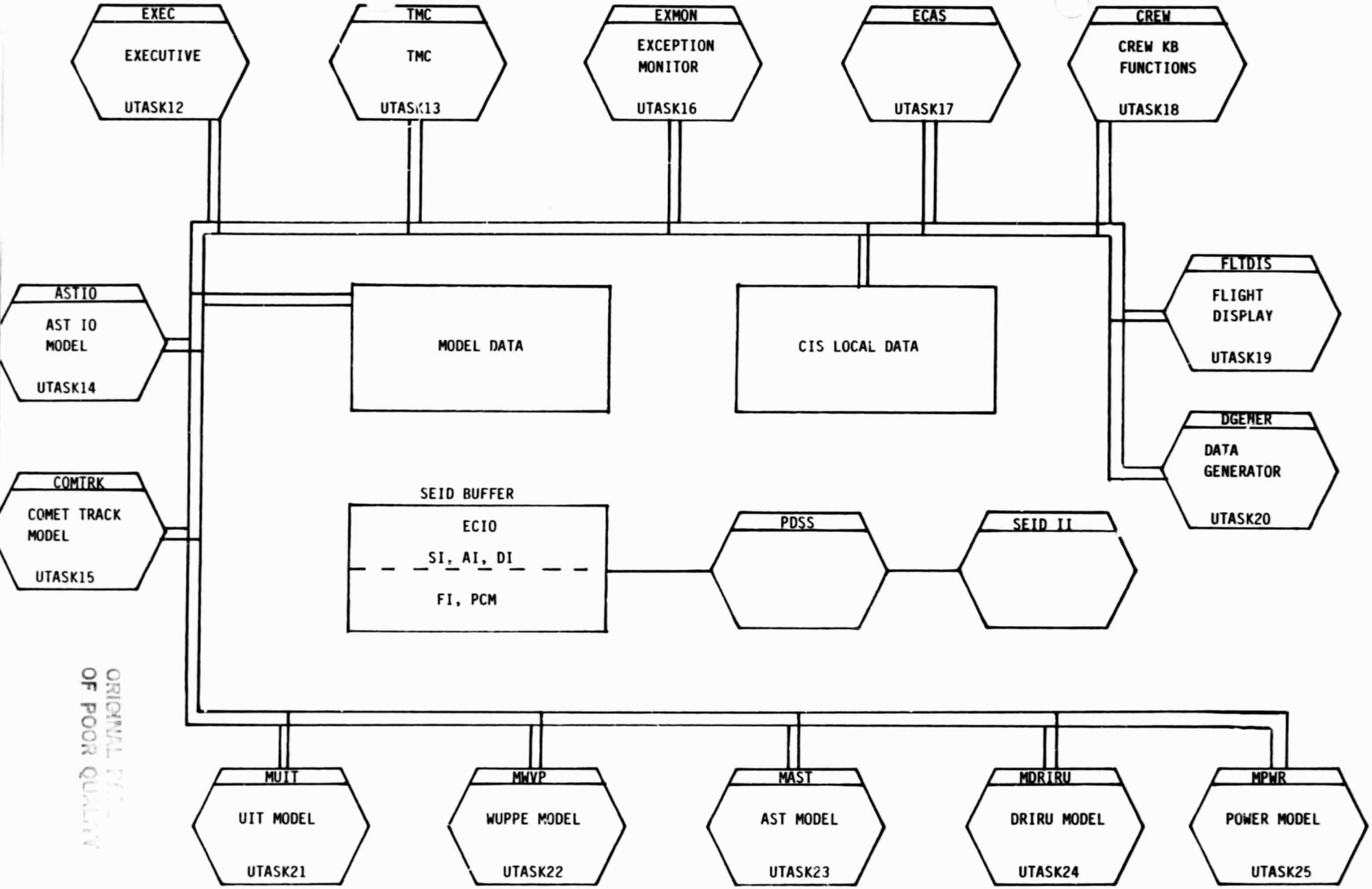


FIGURE A-4: CIS DATA FLOW

ASTROS	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
Cmd clock	RAUS	SOC	*	RAUI	SOC	*
Cmd data	RAUS	SO	*	RAUI	SO	N2
Data xfr rqst	RAUS	SIR	*	RAUI	SIR	*
Data clock	RAUS	SIC	*	RAUI	SIC	*
Serial data	RAUS	SI	*	RAUI	SI	N2
T/E cool pwr on/off	DIO	DO	001	SEID2	FI	00
Spare	DIO	DO	002	SEID2	FI	02
Master reset	DIO	DO	003	SEID2	FI	04
CCD temp	A/D	AI	16	3112	A0	N9A0
Heat sink temp	A/D	AI	17	3112	A0	N9A1
Optics temp	A/D	AI	18	3112	A0	N9A2
EA temp	A/D	AI	19	3112	A0	N9A3
CCD coop pwr	A/D	AI	20	3112	A0	N9A4
Heat #1 pwr	A/D	AI	21	3112	A0	N9A5
Heat #2 pwr	A/D	AI	22	3112	A0	N9A6
Heat #3 pwr	A/D	AI	23	3112	A0	N9A7
+5v	A/D	AI	24	3112	A0	N10A0
+8v	A/D	AI	25	3112	A0	N10A1
+18v	A/D	AI	26	3112	A0	N10A2
-18v	A/D	AI	27	3112	A0	N10A3
ASTBPT	A/D	AI	29	3112	A0	N10A4
Mstr Clk Status	DIO	DI	1	SEID2	DO	0

DRIRU	DEI	TYPE	ADDR	GSE	TYPE	ADDR
/* Incremental Angle Pulse Output */						
+DTXA	DEI	PULSE	*	GYROS	PULSE	N6
-DTXA	DEI	PULSE	*	GYROS	PULSE	N6
+DTXB	DEI	PULSE	*	GYROS	PULSE	N8
-DTXB	DEI	PULSE	*	GYROS	PULSE	N8
+DTYB	DEI	PULSE	*	GYROS	PULSE	N7
-DTYB	DEI	PULSE	*	GYROS	PULSE	N7
+DTYC	DEI	PULSE	*	GYROS	PULSE	N7
-DTYC	DEI	PULSE	*	GYROS	PULSE	N7
+DTZA	DEI	PULSE	*	GYROS	PULSE	N6
-DTZA	DEI	PULSE	*	GYROS	PULSE	N6
+DTZC	DEI	PULSE	*	GYROS	PULSE	N8
-DTZC	DEI	PULSE	*	GYROS	PULSE	N8

FIGURE A-5: PDSS/IMC INTERFACE DEFINITION

```
     /* Electrical Interface Mode Commands */

RRH1A                DEI    DO     *       SEID2   FI      03
RRH2A
RRL1A                DEI    DO     *       SEID2   FI      07
RRL2A
RRH1B                DEI    DO     *       SEID2   FI      11
RRH2B
RRL1B                DEI    DO     *       SEID2   FI      15
RRL2B
RRH1C                DEI    DO     *       SEID2   FI      19
RRH2C
RRL1C                DEI    DO     *       SEID2   FI      23
RRL2C

     /* Range Status Telemetry Output */

RSTX1A               DIO    DI     101     SEID2   DO      16
Spare                DIO    DI     102     SEID2   DO      01
RSTX1B               DIO    DI     103     SEID2   DO      17
Spare                DIO    DI     104     SEID2   DO      03
RSTY1B               DIO    DI     105     SEID2   DO      18
Spare                DIO    DI     106     SEID2   DO      05
RSTY1C               DIO    DI     107     SIED2   DO      19
Spare                DIO    DI     108     SEID2   DO      07
RSTZ1A               DIO    DI     109     SEID2   DO      20
SPARE                DIO    DI     110     SEID2   DO      09
RSTZ1C               DIO    DI     111     SEID2   DO      21
SPARE                DIO    DI     112     SEID2   DO      11

TEMPA                A/D    AI       7     SW      RES     *
TEMPB                A/D    AI       8     SW      RES     *
TEMPC                A/D    AI       9     SW      RES     *

     /* Analog Rate Telemetry Output */

ANRXA                A/D    AI      10     3112    AO      N12A2
ANRXB                A/D    AI      11     3112    AO      N12A3
ANRYB                A/D    AI      12     3112    AO      N12A4
ANRYC                A/D    AI      13     3112    AO      N12A5
ANRZA                A/D    AI      14     3112    AO      N12A6
ANRZC                A/D    AI      15     3112    AO      N12A7

T/MA                 A/D    AI       4     3112    AO      N11A4
T/MB                 A/D    AI       5     3112    AO      N11A5
T/MC                 A/D    AI       6     3112    AO      N11A6
```

FIGURE A-5: PDSS/IMC INTERFACE DEFINITION
(CONTINUED)

WUPPE	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
CLOCK	DEI	SER	*	RIUI	SER	*
DATA	DEI	SER	*	RIUI	SER	N3
ENABLE	DEI	DO	*	RIUI	DI	*
XERR	A/D	AI	*	3112	AO	
YERR	A/D	AI	*	3112	AO	

UIT	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
CLOCK	DEI	SER	*	RIUI	SER	*
DATA	DEI	SER	*	RIUI	SER	N4
XENABLE	DEI	DO	*	RIUI	DI	*
YENABLE	DEI	DO	*	RIUI	DI	*
XERR	A/D	AI	31	3112	AO	N10A6
YERR	A/D	AI	32	3112	AO	N10A7

RAUI	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
Cmd clock	RAUI	SOC	*	SEID2	SOC	PCM CMD CLK O
Cmd data	RAUI	SO	*	SEID2	SO	PCM DTA O
Data xfr rqst	RAUI	SIR	*	SEID2	SIR	PCM DTA REQ O
Data clock	RAUI	SIC	*	SEID2	SIC	PCM DTA CLK O
Serial data	RAUI	SI	*	SEID2	SI	PCM DTA O

TMI	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
TIME	TMI	UTC	*	SEID2	UTC	UTC 1
TIME UPDATE	TMI	UTCU	*	SEID2	UTCU	UTCU 1

HRMI	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
DATA	HRMI	PCM	*	STAGS	PCM	*
CLOCK	HRMI	PCM	*	STAGS	PCM	*

FIGURE A-5: PDSS/IMC INTERFACE DEFINITION
(CONTINUED)

POWER	IMCE	TYPE	ADDR	GSE	TYPE	ADDR
+5V	PWR	AO	*	SEID2	FI	33
+15V	PWR	AO	*	SEID2	FI	37
-15V	PWR	AO	*	SEID2	FI	39
TEMP	PWR	AO	*	SEID2	FI	45
+5V	A/D	AI	0	3112	AO	N11A0
+15V	A/D	AI	1	3112	AO	N11A1
-15V	A/D	AI	2	3112	AO	N11A2
TEMP	A/D	AI	3	3112	AO	N11A3
TEMP CAL INPUT				SEID2	DO	34
+6V	PWR	AO	*	SEID2	FI	35
+24V	PWR	AO	*	SEID2	FI	41
-24V	PWR	AO	*	SEID2	FI	43
STATUS	PWR	AO	*	SEID2	FI	47
-6V	PWR	AO	*	SEID2	FI	49

CPD			
DRIRU X POWER ON	SEID2	DO	48
DRIRU X POWER OFF	SEID2	DO	49
DRIRU Y POWER ON	SEID2	DO	50
DRIRU Y POWER OFF	SEID2	DO	51
DRIRU Z POWER ON	SEID2	DO	52
DRIRU Z POWER OFF	SEID2	DO	53
DRIRU HEATER POWER ON	SEID2	DO	54
DRIRU HEATER POWER OFF	SEID2	DO	55
IMCE POWER ON	SEID2	DO	56
IMCE POWER OFF	SEID2	DO	57
IMCE HEATER ON	SEID2	DO	58
IMCE HEATER OFF	SEID2	DO	59
AST POWER ON	SEID2	DO	60
AST POWER OFF	SEID2	DO	61
EA HEATER ON	SEID2	DO	62
EA HEATER OFF	SEID2	DO	63
SA HEATER ON	SEID2	DO	32
SA HEATER OFF	SEID2	DO	33

FIGURE A-5: PDSS/IMC INTERFACE DEFINITION
(CONTINUED)

INDEX ECIO FI	SIGNAL	AO INDEX	AST UTASK23	MODELS DRIRU UTASK24	SWITCHES	POWER UTASK25	UIT
0	SPARE						
2	SPARE						
4	ANRXA	52		x			
6	ANRXB	54		x			
8	ANRYB	56		x			
10	ANRYC	58		x			
12	ANRZA	60		x			
14	ANRZC	62		x			
16	TEMPA				x		
18	TEMPB				x		
20	TEMPC				x		
22	T/MA	40		x			
24	T/MB	42		x			
26	T/MC	44		x			
28	AST CCD TEMP	0	x				
30	AST HST	2	x				
32	AST OPT	4	x				
34	AST EAT	6	x				
36	AST CCP	8	x				
38	H1P	10	x				
40	H2P	12	x				
42	AST H3P	14	x				
44	AST +5	16	x				
46	AST BPT	26	x				
48	AST +5	18	x				
50	AST +18	20	x				
52	AST -18	22	x				
54	IMCEPST	38				x	
56	PS+5	32				x	
58	PS-15	36				x	
60	PS+15	34				x	
62	ASTSAT	24					
	UITXERR	28					x
	UITYERR	30					x

FIGURE A-6: MODEL ASSIGNMENT

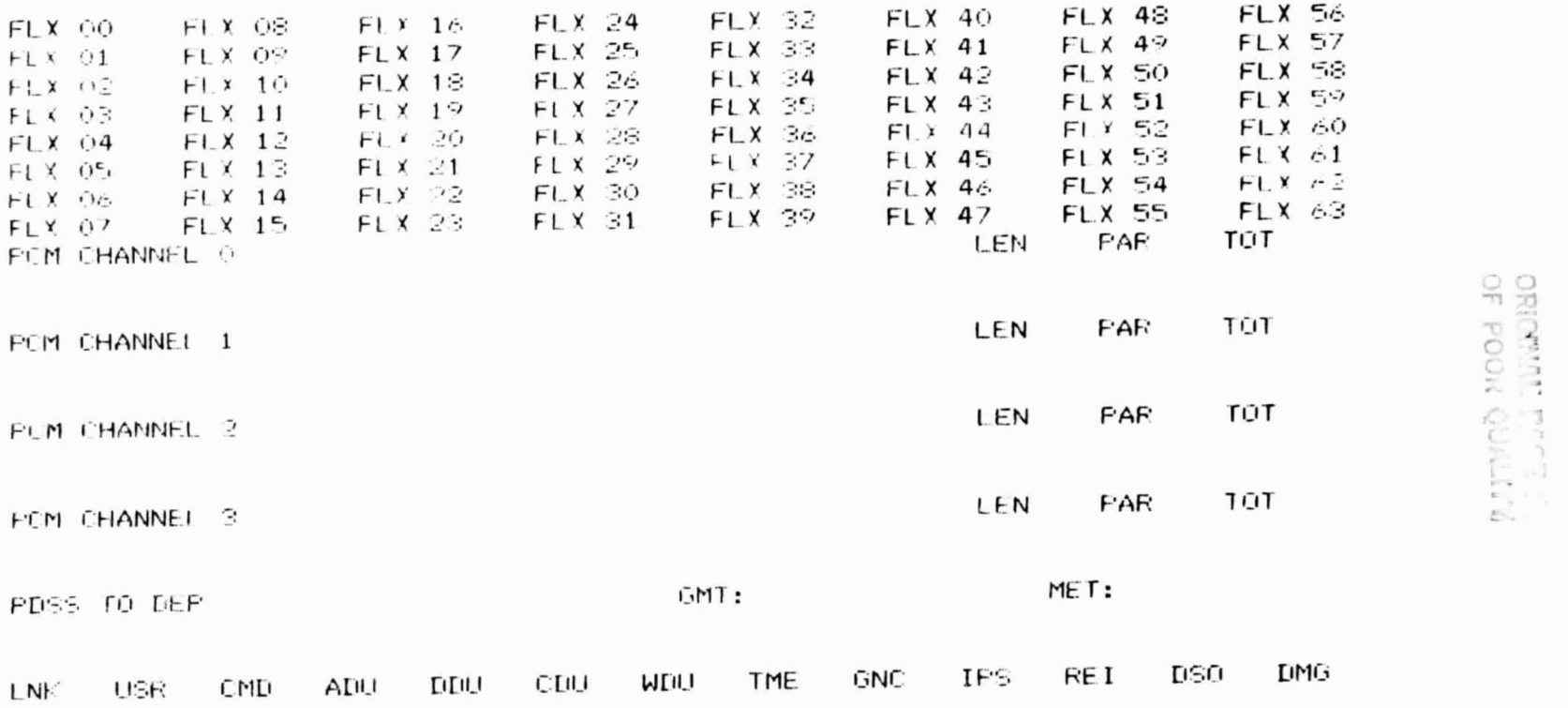


FIGURE A-7: PDSS/IMC MASTER DISPLAY

```
 1 IMC IMAGE MOTION COMP          GMT DD/HH:MM:SS    
 2 T_L_ID NNN H 123456  DIS DIS DIS DIS DIS DIS * 
 3 ON/OFF          STATUS          MODE:SELECT      
 4  1/10 HRTS        XXX             11 STBY*      
 5  2/ 9 IMCE PWR    XXX TEMP +XXX^  12 OPER*      
 6  3    IMCE LOAD                   13 DRIRU*     
 7  4    SELF-TEST   XXXX            14 CMT TRK*   
 8  5/ 8 DRIRU PWR   XXX TEMP +XXX^  15 CAL*       
 9                   XXX TEMP +XXX^                
10                   XXX TEMP +XXX^  22 MIR RESET  
11  6/ 7 AST PWR     XXX TEMP +XXX^                
12                                   FILTER SETTLED* 
13   MAG CODD  AST STAT         COMPUTER DUMPS     
14  +X   +XXX     STBY*     16  AST* 17  DEP* 18  PDD*
15       +XXX     SRCH*       19  ADDR  XXXX XXXX  
16  +X   +XXX     TRK*        20  LNGH  XXXX       
17       +XXX                 21  EXEC*            
18  +X   +XXX                                     
19                                                 
20 ------------------ECML-------------------------
21 ------------------SCML-------------------------
22 ------------------SPL--------------------------
23                                                 
```

FIGURE A-8: RFC DDU DISPLAY

```
 1! ITF IMAGE MOTION COMP          GMT DD/HH:MM:SS    !
 2! T_L_ID NNN H 123456  DIS DIS DIS DIS DIS DIS * !
 3!     IMCE COMMANDS              GYRO CHANNEL XYZ   !
 4! 3916  REBOOT            3917 A B A* 3921 B B A*   !
 5! 3902  SELFTEST ###      3918 A B C* 3922 B B C*   !
 6!     AST COMMANDS        3919 A C A* 3923 B C A*   !
 7! 3925  STANDBY*           3920 A C C* 3924 B C C*   !
 8! 3926  SEARCH*                    DRIRU CHANNEL      !
 9! 3927  SEARCH LFOV*       3906   A HIGH* 3907A LOW*!
10! 3928  RESET DEFECTS      3939   B HIGH* 3941B LOW*!
11! 3929  LED ON*            3942   C HIGH* 3943C LOW*!
12! 3930  LED OFF*                                    !
13! 3931  LIGHT FLOOD ON*                             !
14! 3932  LIGHT FLOOD OFF*          AST SYNCH          !
15! 3933  FRAME START          3908 1HZ*  3912 3HZ*    !
16!  102  SET DEFECTS          3910 2HZ*  3915 4HZ*    !
17!  107  UPDATE INTERVAL                              !
18!  103  TEST COMMAND         DATA ---- ---- ----     !
19!                                                    !
20!-------------------ECML-----------------------------!
21!-------------------SCML-----------------------------!
22!-------------------SPL------------------------------!
23!                                                    !
```

FIGURE A-9: RFC DISPLAY RFC002

```
D04                                    IMC ECIO                                    GMT=DDD,HH,MM,SS
  ANALOG (VOLTAGE +XX.XX)
ANRXA  +0000 ANRXB  +0000 ANRYB  +0000 ANRYC  +0000 ANRZA  +0000 ANRZC  +0000
TEMPA  +0000 TEMPB  +0000 TEMPC  +0000 T/MA   +0000 T/MB   +0000 T/MC   +0000
CCDTEM +0000 ASTHST +0000 ASTOPT +0000 ASTEAT +0000 ASTCPW +0000 ASTH1P +0000
ASTH2P +0000 ASTH3P +0000 AST+5  +0000 ASTBPT +0000 AST+8  +0000 AST+18 +0000
AST-18 +0000 PSTEMP +0000 PS+5   +0000 PS-15  +0000 PS+15  +0000 ASTSAT +0000


  DISCRETE
DDDD DDDD DDDD DDDD DDDD DDDD DDDD DDDD

  SERIAL  XXXX
SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSS
SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSSS SSS

  ANALOG  (ENGINEERING UNITS  +XX.XX)
ANRXA  +0000 ANRXB  +0000 ANRYB  +0000 ANRYC  +0000 ANRZA  +0000 ANRZC  +0000
TEMPA  +0000 TEMPB  +0000 TEMPC  +0000 T/MA   +0000 T/MB   +0000 T/MC   +0000
CCDTEM +0000 ASTHST +0000 ASTOPT +0000 ASTEAT +0000 ASTCPW +0000 ASTH1P +0000
ASTH2P +0000 ASTH3P +0000 AST+5  +0000 ASTBPT +0000 AST+8  +0000 AST+18 +0000
AST-18 +0000 PSTEMP +0000 PS+5   +0000 PS-15  +0000 PS+15  +0000 ASTSAT +0000
```

FIGURE A-10: RFC DISPLAY RFC003

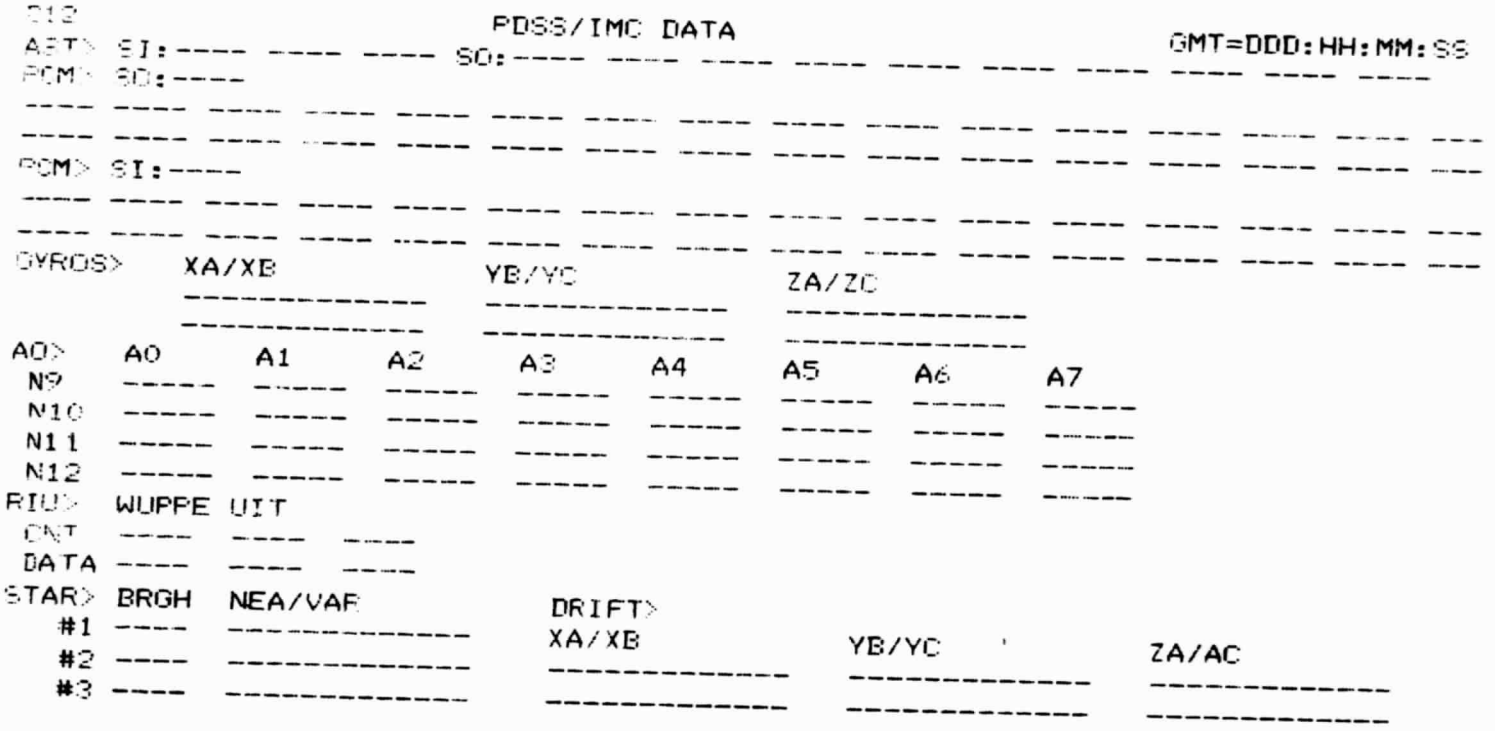


FIGURE A-11: RFC DISPLAY RFC004

```
013                          PDSS/IMC DATA                          GMT=DDD:HH:MM:SS
TASK> ---- ----  GYROF ----

MODEL>     CTRL DATA
 1:DPWR    ---- ---- ---- ---- ----
 2:DAST    ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
 3:DASTAL  ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---
 4:DTMI    ---- ---- ---- ----
 5:DTMA    ---- ---- ---- ----
 6:DTMT    ---- ---- ---- ----
 7:DTMV    ---- ---- ---- ----
 8:DRST    ---- ----
 9:DTRACK  ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
10:DGYRO   ---- ---- ---- ---- ----      ---- ---- ---- ---- ----
11:        ---- ---- ---- ---- ----      ---- ---- ---- ---- ----
12:        ---- ---- ---- ---- ----      ---- ---- ---- ---- ----
13:DRATE   ---- ---- ---- ---- ---- ---- ----
14:TEST    ---- ----
```

FIGURE A-12: RFC DISPLAY RFC005

I. SIMULATED CPD

SEID	FUNCTION
"PULSE 32, ON"	IMCE POWER ON
"PULSE 33, ON"	IMCE POWER OFF

II. CPD

POWER UP

SEID	ITEM ENTRY	FUNCTION
"PULSE 48,ON"	5	DRIRU A POWER ON
"PULSE 50,ON"	5	DRIRU B POWER ON
"PULSE 52,ON"	5	DRIRU C POWER ON
"PULSE 56,ON"	2	IMCE POWER ON
"PULSE 58,ON"	1	IMCE HEATER ON
"PULSE 60,ON"	6	AST POWER ON
"PULSE 62,ON"	1	AST EA HEATER ON
"PULSE 32,ON"	1	AST SA HEATER ON

POWER DOWN

SEID	ITEM ENTRY	FUNCTION
"PULSE 49,ON"	8	DRIRU A POWER DOWN
"PULSE 51,ON"	8	DRIRU B POWER DOWN
"PULSE 53,ON"	8	DRIRU C POWER DOWN
"PULSE 57,ON"	9	IMCE POWER OFF
"PULSE 59,ON"	10	IMCE HEATER OFF
"PULSE 61,ON"	7	AST POWER OFF
"PULSE 63,ON"	10	AST EA HEATER OFF
"PULSE 33,ON"	10	AST SA HEATER OFF

FIGURE A-13: IMCE POWER UP/DOWN COMMANDS

DDU CATEGORY

Command	Parameters	Function
=I	item-number hex-data ...	DDU Item Entry
=P	pfk-number	DDU PFK Entry
=T	hex-data	DDU Type Entry
=C	C-type sid hex-data ...	DDU CMD Entry

SYSTEM COMMAND CATEGORY

Command	Parameters	Function
=TASK	task-mask	Select Tasks
=CTRL	control-key [integer-data]	System Control
=VIEW	[view-key][addr]	View Memory Data
=TMC	tmc-command [filename]	Run Timed Measurement Commands
=LOG	[addr number-words]	Run Log
=STOP		Stop Task
=DISP	display-key pid	Select Display Page
=PMEM		Print Display Pages
=SRST		System Reset
=STAR		Start
=COMM	comment-character-string	Enter Log Comment
=MOD	addr hex-data ... hex-data	Modify Memory
=DATA	data-index data-code [hex-data...]	Model Data
=WAO	wao-index hex-data	Write CAMAC AO
=RUN	run-code	Executive Run

FIGURE A-14: KEYBOARD COMMANDS

```
addr                        =  octal address
c-type                      =  ["WRI", "ISS"]
comment-character-string    =  character string of length 16
control-key                 =  ["/V","/M","/E","/T"]
data-code                   =  [-1,0,+1]
data-index                  =  [1,2,...,14]
display-key                 =  ["/I","/F","/U"]
filename                    =  RT-11 filename
hex-data                    =  array [1...4] of hex-characters
integer-data                =  integer
item-number                 =  [1...22]
number-words                =  integer
pfk-number                  =  [0]
pid                         =  [1,2,3,4,5]
run-code                    =  [-1,0,+1]
sid                         =  signal identifier
task-mask                   =  hex-data
tmc-command                 =  [RUN,STOP,HOLD,GO]
view-key                    =  ["/S"]
wao-index                   =  [0,2,4,6,...,60,62]
```

FIGURE A-14: KEYBOARD COMMANDS
(CONTINUED)

ITEM	PARAMETERS	FUNCTION		
1		HTRS ENA		
2		IMCE PWR ON		
3		IMCE LOAD		
4		SELF TEST		
5		DRIRU PWR ON		
6		AST PWR ON		
7		AST PWR OFF		
8		DRIRU PWR OFF		
9		IMCE PWR OFF		
10		HTRS INHIBIT		
11		IMCE STBY		
12		IMCE OPEN		
13		IMCE DRIRU		
14		IMCE CMTRK		
15		CAL		
16		AST DUMP		
17		DEP DUMP		
18		PCC DUMP		
19	aaaa bbbb	START		
			aaaa	bbbb
		AST	0000	AST address(hex)
		DEP	blank(hex)	offset(hex)
		PCC	0000	PCC address(hex)
20	cccc	LNGH=length in words (decimal)		
21		EXEC		
22		MIRROR RS		

FIGURE A-15: ITEM ENTRY SUMMARY

TIME VARIABLE	(SECS) DEFAULT	TASK MASK	TASK/FUNCTION
T1	1.0		
T2	2.0		
T3	1.0		
T4	1.0		
T5	10.0		
T6	2.0		TEST-MMU LOAD
T7	15.0		AST ACO TIME
T8	1.0		
T9	1.0		
T10	1.0		
T11	1.0		
T12	1.0		TASK 12 - EXECUTIVE
T13	1.0	1	TASK 13 - TMC
T14	1.0	2	TASK 14 - AST CYCLIC
T15	1.0	3	TASK 15 - COMTRK
T16	1.0	4	TASK 16 - EXMON
T17	1.0	5	TASK 17 - ECAS
T18	1.0	6	TASK 18 - CREW
T19	1.0	7	TASK 19 - FLTDIS
T20	1.0	8	TASK 20 - DGENER
T21	10.0		TASK 21 - UIT MODEL
T22	10.0	10	TASK 22 - WUPPE MODEL
T23	1.0	11	TASK 23 - AST MODEL
T24	1.0	12	TASK 24 - DRIRU MODEL
T25	1.0	13	TASK 25 - POWER MODEL
T26	1.0	14	TASK 26 - LOG FUNCTION
T27	1.0	15	TASK 27 - DISPLAY UPDATE
T28	1.0		TASK 28 - KEYBOARD MONITO

FIGURE A-16: TASKS

index	DATA	# WORDS	DEFAULT					
1	DPWR	4.	852.	764.	764.	260.		
2	DAST	10.	3203	4987	03E8	1000	2000	1000
			0000	8000				
3	DASTAL	14.	4000	0060	696.	410.	1023.	731.
			731.	731.	1796	1486.	1675.	-1675.
			619.	622.				
4	DTMI	3.	851.	776.	245.			
5	DTMA	3.	12.	13.	10.			
6	DTMT	3.	45.	35.	43.			
7	DTMV	3.	260.	305.	323.			
8	DRST	1.	0000					
9	DTRACK	9.	0000	0000	0000	0000	0000	0000
			0000	0000	0000			
10	DGYRO	8.	0100	8200	0200	8100	0100	8200
			0200	8100				
11	DGYRO+16.	8.	0060	8020	0020	8060	0060	8020
			0020	8060				
12	DGYRO+32.	8.	80A0	0050	8080	00A0	80A0	0080
			8080	00A0				
13	DRATE	6.	0800	0800	0400	0400	0200	0200
14	DTEST	8.						

FIGURE A-17: MODEL DATA CONTROL

	DEFAULT VALUE	SIGNAL	CAMAC AO INDEX	DESCRIPTION
DPWR				IMCE Analog Output Signals
(1)	852.	PWR+5V	32	
(2)	764.	PWR+15V	34	
(3)	764.	PWR-15V	36	
(4)	260.	IMCE TEMP	38	
DAST		ASTSO		AST Serial Output 3203 4987 03E8 1000 3000 1000 0000 8000 4000 0060
DASTAL	1740.	(-50.c) CCDTEMP	0	AST Analog Output Signals
	532.	(+20.c) HS TEMP	2	
	696.	(+20.c) OPTICS TEMP	4	
	410.	(+40.c) EA TEMP	6	
	1023.	(5v) HEAT #1 PWR	10	
	731.	(-5v) HEAT #2 PWR	12	
	731.	(-5v) HEAT #3 PWR	14	
	1796.	(+5v) AST+5v	16	
	1486.	(+18v) AST+8v	18	
	1675.	(+18v) AST+18v	20	
	-1675.	(-18v) AST-18v	22	
	619.	(20c) BP TEMP	26	
	622.	(20c) SA TEMP	24	

FIGURE A-18: MODEL DATA DESCRIPTION

	DEFAULT VALUE	SIGNAL	CAMAC AO INDEX	DESCRIPTION
DTMI	851., 776., 945.			DRIRU Gyro Spinup Power Up
DTMA	12., 13., 10.			FOR I=1 TO DTMT
DTMT	45., 35., 43.			DTMV(I)=DTMV(I-1)+DTMA
				where DTMV(0)=DTMI
DTMU	260.	T/MA	40	DRIRU Gyro Currents
	305.	T/MB	42	
	323.	T/MC	44	
DRST	0	ANRXA	52	
		ANRXB	54	
		ANRYB	56	
		ANRYC	58	
		ANRZA	60	
		ANRZC	62	
DTRACK				Comet Track
				0000 0000 0000 0000 0000 0000
				0000 0000 0000
DGYRO				Gyro Channel Pulses
				xxxx xxxx xxxx xxxx
				(1) (2) (3) (4)

FIGURE A-18: MODEL DATA DESCRIPTION
(CONTINUED)

DEFAULT VALUE	SIGNAL	CAMAC AO INDEX	DESCRIPTION
			Gyro's Loaded (1) (2) (3) (4) xxxx = 0 Stops Gyro Output xxxx = Sign + data
DRATE			Gyro Rates 0800 0500 0400 0400 0400 0200 0200
DTEST			Test Data 000A 0000 0000 0000 0000 0000 0000 0000

FIGURE A-18: MODEL DATA DESCRIPTION
(CONTINUED)

index	CAMAC IO	FUNCTION
0	N(9)A(0)	CCD TEMP
2	1	HEAT SINK TEMP
4	2	OPTICS TEMP
6	3	EA TEMP
8	4	CCD LOOP PWR
10	5	HEAT #1 PWR
12	6	HEAT #2 PWR
14	7	HEAT #3 PWR
16	N(10)A(0)	+5V AST
18	1	+8V AST
20	2	+18V AST
22	3	-18V AST
24	4	SA ELECTRONICS
26	5	BASE PLATE TEMP
28	6	UIT XERR
30	7	UIT YERR
32	N(11)A(0)	PWR +5V
34	1	PWR +15V
36	2	PWR -15V
38	3	IMCE TEMP
40	4	T/MA
42	5	T/MB
44	6	T/MC
46	7	
48	N(12)A(0)	
50	1	
52	2	ANRXA
54	3	ANRXB
56	4	ANRYB
58	5	ANRYC
60	6	ANRZA
62	7	ANRZC

FIGURE A-19: WAO COMMAND DATA

MMU DATA LISTING
4 OCT 1984

BYTE	XXXX XXXX	VALUE	DESCRIPTION
0000	018D	FLTX+FIX	NUMBER OF WORDS
0002	0003	3	ALLOWED-FAILURES
0004	05DC	1500.	AST-TO-COUNT
0006	000A	10.	KDL
0008	0000 4248	50.0	TOL-P-B
0012	0000 42C8	100.0	TOL-C-P
0016	0000 40C0	6.0	C-TOL
0020	0000 4000	2.0	AST-BRIGHTNESS-TOL
0024	0000 4000	2.0	AST-MOTION-TOLERANCE
0028	0000 4120	10.0	W-CAL-AMPLITUDE
0032	999A 436F	2.396E+2	BORE-SIGHT-COL
0036	0CCD 4391	2.901E+2	BORE-SIGHT-LINE
0040	0000 4228	42.0	UIT-MAX
0044	E148 4136	11.43	WUPPE-MAX
0048	0000 41A0	20.0	AVERAGE-CONST
0052	A5E3 3C9B	0.019	GYRO-NOISE [1,1]
0056	5C29 3D0F	0.035	[2,1]
0060	748C 3C99	0.018	[3,1]
0064	CCCD 3D4C	0.050	[4,1]
0068	6A7F 3CBC	0.023	[5,1]
0072	D70A 3D23	0.040	[6,1]
0076	0000 0000	0.0	GYRO-ACTIVE-SELECTOR [1,1]
0080	0000 3F80	1.0	[1,2]
0084	0000 3F80	1.0	[1,3]
0088	0000 0000	0.0	[1,4]
0092	0000 0000	0.0	[1,5]
0096	0000 0000	0.0	[1,6]
0100	0000 0000	0.0	[2,1]
0104	0000 0000	0.0	[2,2]
0108	0000 0000	0.0	[2,3]
0112	0000 3F80	1.0	[2,4]
0116	0000 0000	0.0	[2,5]
0120	0000 3F80	1.0	[2,6]
0124	0000 3F80	1.0	[3,1]
0128	0000 0000	0.0	[3,2]
0132	0000 0000	0.0	[3,3]
0136	0000 0000	0.0	[3,4]
0140	0000 3F80	1.0	[3,5]
0144	0000 0000	0.0	[3,6]
0148	0000 0000	0.0	GYRO-PRIME-SELECTOR [1,1]
0152	0000 3F80	1.0	[1,2]
0156	0000 0000	0.0	[1,3]
0160	0000 0000	0.0	[1,4]
0164	0000 0000	0.0	[1,5]
0168	0000 0000	0.0	[1,6]
0172	0000 0000	0.0	[2,1]
0176	0000 0000	0.0	[2,2]
0180	0000 0000	0.0	[2,3]

FIGURE A-20: IMCE MMU LOAD SPECIFICATIONS

BYTE	XXXX	XXXX	VALUE	DESCRIPTION
0184	0000	0000	0.0	[2,4]
0188	0000	0000	0.0	[2,5]
0192	0000	3F80	1.0	[2,6]
0196	0000	3F80	1.0	[3,1]
0200	0000	0000	0.0	[3,2]
0204	0000	0000	0.0	[3,3]
0208	0000	0000	0.0	[3,4]
0212	0000	0000	0.0	[3,5]
0216	0000	0000	0.0	[3,6]
0220	0000	0000	0.0	GYRO-BACKUP-SELECTOR [1,1]
0224	0000	0000	0.0	[1,2]
0228	0000	3F80	1.0	[1,3]
0232	0000	0000	0.0	[1,4]
0236	0000	0000	0.0	[1,5]
0240	0000	0000	0.0	[1,6]
0244	0000	0000	0.0	[2,1]
0248	0000	0000	0.0	[2,2]
0252	0000	0000	0.0	[2,3]
0256	0000	3F80	1.0	[2,4]
0260	0000	0000	0.0	[2,5]
0264	0000	0000	0.0	[2,6]
0268	0000	0000	0.0	[3,1]
0272	0000	0000	0.0	[3,2]
0276	0000	0000	0.0	[3,3]
0280	0000	0000	0.0	[3,4]
0284	0000	3F80	1.0	[3,5]
0288	0000	0000	0.0	[3,6]
0292	0000	0000	0.0	GYRO-SCALE-FACTORS [1,1]
0296	0000	0000	0.0	[1,2]
0300	CE7A	3C4C	0.0125004	[1,3]
0304	D4C5	3C4C	0.0125019	[2,1]
0308	0000	0000	0.0	[2,2]
0312	0000	0000	0.0	[2,3]
0316	2490	3C4C	0.0124599	[3,1]
0320	0000	0000	0.0	[3,2]
0324	0000	0000	0.0	[3,3]
0328	0000	0000	0.0	[4,1]
0332	55AF	3C4C	0.0124716	[4,2]
0336	0000	0000	0.0	[4,3]
0340	0000	0000	0.0	[5,1]
0344	0000	0000	0.0	[5,2]
0348	4553	3C4C	0.0124677	[5,3]
0352	0000	0000	0.0	[6,1]
0356	7C45	3C4C	0.0124808	[6,2]
0360	0000	0000	0.0	[6,3]
0364	0000	0000	0.0	PRELAUNCH-DRIFT-RATES [1,1]
0368	0000	0000	0.0	[1,2]
0372	C63F	BF6C	-0.9249	[1,3]

FIGURE A-20: IMCE MMU LOAD SPECIFICATIONS
(CONTINUED)

BYTE	XXXX	XXXX	VALUE	DESCRIPTION
0376	7DBF	3EDD	-0.4326	[2,1]
0380	0000	0000	0.0	[2,2]
0384	0000	0000	0.0	[2,3]
0388	7803	BF4B	-0.7948	[3,1]
0392	0000	0000	0.0	[3,2]
0396	0000	0000	0.0	[3,3]
0400	0000	0000	0.0	[4,1]
0404	5D64	BEDC	-0.4304	[4,2]
0408	0000	0000	0.0	[4,3]
0412	0000	0000	0.0	[5,1]
0416	0000	0000	0.0	[5,2]
0420	126F	BFE3	-1.774	[5,3]
0424	0000	0000	0.0	[6,1]
0428	ED91	3EBC	+0.3690	[6,2]
0432	0000	0000	0.0	[6,3]
0436	311F	2D3F	1.0868E-11	NEA-TABLE [1,1]
0440	FD4E	2CAE	4.9735E-12	[2,1]
0444	1910	2C0B	1.9767E-12	[3,1]
0448	1A5C	2BA0	1.1376E-12	[4,1]
0452	3348	2B3F	6.7928E-13	[5,1]
0456	AC37	2B01	4.6069E-13	[6,1]
0460	893A	2ABE	3.3846E-13	[7,1]
0464	1A5C	2AA0	2.8440E-13	[8,1]
0468	50D5	2A84	2.3504E-13	[9,1]
0472	50D5	2A84	2.3504E-13	[10,1]
0476	5C2E	2A56	1.9039E-13	[11,1]
0480	5C2E	2A56	1.9039E-13	[12,1]
0484	5E7F	2A29	1.5043E-13	[13,1]
0488	5E7F	2A29	1.5043E-13	[14,1]
0492	AB7E	2A01	1.1517E-13	[15,1]
0496	AB7E	2A01	1.1517E-13	[16,1]
0500	AB7E	2A01	1.1517E-13	[17,1]
0504	89CE	29BE	8.4616E-14	[18,1]
0508	89CE	29BE	8.4616E-14	[19,1]
0512	89CE	29BE	8.4616E-14	[20,1]
0516	89CE	29BE	8.4616E-14	[21,1]
0520	89CE	29BE	8.4616E-14	[22,1]
0524	5169	2984	5.8761E-14	[23,1]
0528	5169	2984	5.8761E-14	[24,1]
0532	5169	2984	5.8761E-14	[25,1]
0536	5169	2984	5.8761E-14	[26,1]
0540	5169	2984	5.8761E-14	[27,1]
0544	5169	2984	5.8761E-14	[28,1]
0548	5169	2984	5.8761E-14	[29,1]
0552	5169	2984	5.8761E-14	[30,1]
0556	5169	2984	5.8761E-14	[31,1]
0560	0000	3F80	1.0	P-TRANSFORM [1,1]
0564	0000	0000	0.0	[1,2]

FIGURE A-20: IMCE MMU LOAD SPECIFICATIONS
(CONTINUED)

BYTE	XXXX YYYY	VALUE	DESCRIPTION
0568	0000 0000	0.0	[1,3]
0572	0000 0000	0.0	[2,1]
0576	0000 3F80	1.0	[2,2]
0580	0000 0000	0.0	[2,3]
0584	0000 0000	0.0	[3,1]
0588	0000 0000	0.0	[3,2]
0592	0000 3F80	1.0	[3,3]
0596	0000 3F80	1.0	PA-TRANSFORM [1,1]
0600	0000 0000	0.0	[1,2]
0604	0000 0000	0.0	[1,3]
0608	0000 0000	0.0	[2,1]
0612	0000 3F80	1.0	[2,2]
0616	0000 0000	0.0	[2,3]
0620	0000 0000	0.0	[3,1]
0624	0000 0000	0.0	[3,2]
0628	0000 3F80	1.0	[3,3]
0632	0000 3F80	1.0	U-TRANSFORM [1,1]
0636	0000 0000	0.0	[1,2]
0640	0000 0000	0.0	[1,3]
0644	0000 0000	0.0	[2,1]
0648	0000 3F80	1.0	[2,2]
0652	0000 0000	0.0	[2,3]
0656	0000 0000	0.0	[3,1]
0660	0000 0000	0.0	[3,2]
0664	0000 3F80	1.0	[3,3]
0668	0000 3F80	1.0	W-TRANSFORM [1,1]
0672	0000 0000	0.0	[1,2]
0676	0000 0000	0.0	[1,3]
0680	0000 0000	0.0	[2,1]
0684	0000 3F80	1.0	[2,2]
0688	0000 0000	0.0	[2,3]
0692	0000 0000	0.0	[3,1]
0696	0000 0000	0.0	[3,2]
0700	0000 3F80	1.0	[3,3]
0704	BF95 33D6	1.0E-7	ERR-COVAR-MAT [1,1]
0708	CC77 322B	1.0E-8	[1,2]
0712	CC77 322B	1.0E-8	[1,3]
0716	CC77 322B	1.0E-8	[1,4]
0720	BF95 33D6	1.0E-7	[2,1]
0724	CC77 322B	1.0E-8	[2,2]
0728	CC77 322B	1.0E-8	[2,3]
0732	CC77 322B	1.0E-8	[2,4]
0736	BF95 33D6	1.0E-7	[3,1]
0740	CC77 322B	1.0E-8	[3,2]
0744	CC77 322B	1.0E-8	[3,3]
0748	CC77 322B	1.0E-8	[3,4]
0752	BF95 33D6	1.0E-7	[4,1]
0756	CC77 322B	1.0E-8	[4,2]

FIGURE A-20: IMCE MMU LOAD SPECIFICATIONS
(CONTINUED)

MMU DATA LISTING
4 OCT 1984

BYTE	XXXX XXXX	VALUE	DESCRIPTION
0760	CC77 322B	1.0E-8	[4,3]
0764	CC77 322B	1.0E-8	[4,4]
0768	0000	0	NUMBER-DEFECT-COORDS
0770	0000	0	DEFECT-COORDS [1,1]
0772	0000	0	[2,1]
0774	0000	0	[3,1]
0776	0000	0	[4,1]
0778	0000	0	[5,1]
0780	0000	0	[6,1]
0782	0000	0	[7,1]
0784	0000	0	[8,1]
0786	0000	0	[9,1]
0788	0000	0	[10,1]
0790	00FA	250.	#CYCLES FASTLOOP INIT
0792	E081	0	SENT-CHECKSUM

FIGURE A-20: IMCE MMU LOAD SPECIFICATIONS
(CONTINUED)

```
MMU FILE:EMMUP.IMC  #WORDS=397
4 OCT 1984

BLOCK=000000
0000    018D 0003 05DC 000A 0000 4248 0000 42C8 0000 40C0 0000 4000 0000 4000 0000 4120
0010    999A 436F 0CCD 4391 0000 4228 E148 4136 0000 41A0 A5E3 3C9B 5C29 3D0F 74BC 3C93
0020    CCCD 3D4C 6A7F 3CBC D70A 3D23 0000 0000 0000 3F80 0000 3F80 0000 0000 0000 0000
0030    0000 0000 0000 0000 0000 0000 0000 0000 0000 3F80 0000 0000 0000 3F80 0000 3F80
0040    0000 0000 0000 0000 0000 0000 0000 3F80 0000 0000 0000 0000 0000 3F80 0000 0000
0050    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0060    0000 3F80 0000 3F80 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0070    0000 0000 0000 3F80 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0080    0000 3F80 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 3F80
0090    0000 0000 0000 0000 0000 0000 CE7A 3C4C D4C5 3C4C 0000 0000 0000 0000 249C 3C4C
00A0    0000 0000 0000 0000 0000 0000 55AF 3C4C 0000 0000 0000 0000 0000 0000 4553 3C4C
00B0    0000 0000 7C45 3C4C 0000 0000 0000 0000 0000 0000 C63F BF6C 7DBF BEDD 0000 0000
00C0    0000 0000 7803 BF4B 0000 0000 0000 0000 0000 0000 5D64 BEDC 0000 0000 0000 0000
00D0    0000 0000 126F BFE3 0000 0000 ED91 3EBC 0000 0000 311F 2D3F FD4E 2CAE 1910 2C0B
00E0    1A5C 2BA0 3348 2B3F AC37 2B01 893A 2ABE 1A5C 2AA0 50D5 2A84 50D5 2A84 5C2E 2A56
00F0    5C2E 2A56 5E7F 2A29 5E7F 2A29 AB7E 2A01 AB7E 2A01 AB7E 2A01 89CE 29BE 89CE 29BE

BLOCK=000001
0100    89CE 29BE 89CE 29BE 89CE 29BE 5169 2984 5169 2984 5169 2984 5169 2984 5169 2984
0110    5169 2984 5169 2984 5169 2984 5169 2984 0000 3F80 0000 0000 0000 0000 0000 0000
0120    0000 3F80 0000 0000 0000 0000 0000 0000 0000 3F80 0000 3F80 0000 0000 0000 0000
0130    0000 0000 0000 3F80 0000 0000 0000 0000 0000 0000 0000 3F80 0000 3F80 0000 0000
0140    0000 0000 0000 0000 0000 3F80 0000 0000 0000 0000 0000 0000 0000 3F80 0000 3F80
0150    0000 0000 0000 0000 0000 0000 0000 3F80 0000 0000 0000 0000 0000 0000 0000 3F80
0160    BF95 33D6 CC77 322B CC77 322B CC77 322B BF95 33D6 CC77 322B CC77 322B CC77 322B
0170    BF95 33D6 CC77 322B CC77 322B CC77 322B BF95 33D6 CC77 322B CC77 322B CC77 322B
0180    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 00FA E081 0000 0000 0000
0190    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
01A0    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
01B0    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
01C0    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
01D0    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
01E0    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
01F0    0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

FIGURE A-21: DEP MEMORY LOAD

NAME	DESCRIPTION	SAMPLE RATE	SIZE (BITS)	SPSANL INDEX
	Spare	1	8	0
	Spare	1	8	1
ANRXA	X Axis Rate A	1	8	2
ANRXB	X Axis Rate B	1	8	3
ANRYB	Y Axis Rate B	1	8	4
ANRYC	Y Axis Rate C	1	8	5
ANRZA	Z Axis Rate A	1	8	6
ANRZC	Z Axis Rate C	1	8	7
TEMPA	A GYRO Temperature	1	8	8
TEMPB	B GYRO Temperature	1	8	9
TEMPC	C GYRO Temperature	1	8	10
T/MA	A GYRO Motor Current	1	8	11
T/MB	B GYRO Motor Current	1	8	12
T/MC	C GYRO Motor Current	1	8	13
CCDTEM	AST CCD Temperature	1	8	14
ASTHST	AST Heat Sink Temperature	1	8	15
ASTOPT	AST Optics Temperature	1	8	16
ASTEAT	AST EA Temperature	1	8	17
ASTCPW	AST CCD Cooler Volt	1	8	18
ASTH1P	AST Heater #1 Volt	1	8	19
ASTH2P	AST Heater #2 Volt	1	8	20
ASTH3P	AST Heater #3 Volt	1	8	21
AST+5	AST +5 Volts	1	8	22
ASTBPT	AST Baseplate Temperature	1	8	23
AST+8	AST +8 Volts	1	8	24
AST+18	AST +18 Volts	1	8	25
AST-18	AST -18 Volts	1	8	26
PSTEMP	IMCE Temperature	1	8	27
PS+5	PS +5	1	8	28
P5-15	PS -15 Volts	1	8	29
PS+15	PS +15 Volts	1	8	30
ASTSAT	AST SA Electronics Temperature	1	8	31

Data deposited in SPSANL

FIGURE A-22: ECIO ANALOG DATA

DESCRIPTION			NUMBER OF BITS	BIT POSITION	DATA TYPE
DEP Software Status Parent Word 1					
-Load MMU	On/Off	DEP 1-01	1	15	B
-Load OK	Y/N	DEP 1-02	1	14	B
-Test	Go/Nogo	DEP 1-03	1	13	B
-DRI Mode	Hi/Lo	DEP 1-04	1	12	B
-Standby	On/Off	DEP 1-05	1	11	B
-Operate	On/Off	DEP 1-06	1	10	B
-DRI (Only)	On/Off	DEP 1-07	1	9	B
-Mirror Reset	On/Off	DEP 1-08	1	8	B
-Comet	On/Off	DEP 1-09	1	7	B
-Calibrate	On/Off	DEP 1-10	1	6	B
-AST Standby	Y/N	DEP 1-11	1	5	B
-AST Search	Y/N	DEP 1-12	1	4	B
-AST Track	Y/N	DEP 1-13	1	3	B
-Filter Settled	Y/N	DEP 1-14	1	2	B
-IMCE Power	On/Off	DEP 1-15	1	1	B
-AST Dump	Y/N	DEP 1-16	1	0	B
DEP Software Status Parent Word 2					
-XA YB ZA		DEP 2-01	1	15	B
-XA YB ZC		DEP 2-02	1	14	B
-XA YC ZA		DEP 2-03	1	13	B
-XA YC ZC		DEP 2-04	1	12	B
-XB YB ZA		DEP 2-05	1	11	B
-XB YB ZC		DEP 2-06	1	10	B
-XB YC ZA		DEP 2-07	1	9	B
-XB YC ZC		DEP 2-08	1	8	B
-PCC Dump	On/Off	DEP 2-09	1	7	B
-Spare			7	0-6	B

FIGURE A-23: ECIO DISCRETE DATA

DESCRIPTION			NUMBER OF BITS	BIT POSITION	DATA TYPE
DEP Hardware Status Parent Word					
-1 Memory Error			1	15	B
-2 PCC Communication Error			1	14	B
-3 System Interrupt Error			1	13	B
-4 8087 Computational Error			1	12	B
-5 Running in Monitor			1	11	B
-6 Error 6			1	10	B
-7 Error 7			1	9	B
-8 Error 8			1	8	B
-9 Error 9			1	7	B
-10 Error 10			1	6	B
-11 Error 11			1	5	B
-12 Error 12			1	4	B
-13 Error 13			1	3	B
-14 Error 14			1	2	B
-15 Error 15			1	1	B
-16 error 16			1	0	B
PCC Software Statue Parent Word 1					
-Telemetry	On/Off	PCC01	1	15	B
-RAU	On/Off	PCC02	1	14	B
-Spare			11	13-3	B
-PCC Memory Test	Error/Noerr	PCC14	1	2	B
-Spare			2	1-0	B
Group 1 DI Parent Word					
-Spare			10	15-6	B
-DRI Range Status ZC DI			1	5	B
-DRI Range Statue ZA DI			1	4	B
-DRI Range Status YC DI			1	3	B
-DRI Range Status YB DI			1	2	B
-DRI Range Status XB DI			1	1	B
-DRI Range Status XB DI			1	1	B
-DRI Range Status XA DI			1	0	N

FIGURE A-23: ECIO DISCRETE DATA
(CONTINUED)

DESCRIPTION	NUMBER OF BITS	BIT POSITION	DATA TYPE
DRI Mode Command Group DO's Parent Word			
-Spare	10	15-6	B
-DRI Mode Command C, Low	1	5	B
-DRI Mode Command C, High	1	4	B
-DRI Mode Command B, Low	1	3	B
-DRI Mode Command B, High	1	2	B
-DRI Mode Command A, Low	1	1	B
-DRI Mode Command A, High	1	0	B
RAUI Status Parent Word			
-Spare	10	15-6	B
-PCO Buffer Overflow	1	5	B
-RAU Did Not Take All RAUI Data	1	4	B
-PCU Data Word Parity Error	1	3	B
-STSW Parity Error	1	2	B
-Non-Valid STSW	1	1	B
-Parity Bit	1	0	B
Group 0 DI Parent Word			
-Master Clock Status	1	15	B
-Spare	15	14-0	B

Data deposited in SPSDIS

FIGURE A-23: ECIO DISCRETE DATA
(CONTINUED)

DESCRIPTION	NUMBER OF BITS	BIT POSITION	DATA TYPE
AST Wrap Around Counter	16	0	U
AST Data Word 1 Parent	16		
-AST Update Interval (MS)	9	15-7	U
-AST Memory Dump On/Off	1	6	B
-AST Self Test Star On/Off	1	5	B
-AST Error Flag Normal/Error	1	4	B
-AST Thermoelectric Cooler Power On/Off	1	3	B
-AST Rate Flag	1	2	B
-AST Operation Mode	2	1-0	U
AST Data Word 2 Parent	16	0	N
-AST Light Flood Status	1	15	B
-AST Brightness of 1st Star	5	14-10	U
-AST Brightness of 2nd Star	5	9-5	U
-AST Brightness of 3rd Star	5	4-0	U
AST Data Word 3 Parent	16	0	N
-AST Error Number	4	15-12	N
-AST Integration Time (MS)	12	11-0	U
AST Vertical Coord. of 1st Star (16 LSB)	16	0	U
AST Horizontal Coord. of 1st Star (16 LSB)	16	0	U
AST Vertical Coord. of 2nd Star (16 LSB)	16	0	U
AST Horizontal Coord. of 2nd Star (16 LSB)	16	0	U
AST Vertical Coord. of 3rd Star (16 LSB)	16	0	U
AST Horizontal Coord. of 3rd Star (16 LSB)	16	0	U
AST Data Word 10 Parent	16	0	N
-Spare	4	15-12	
-AST Vertical Coord. of 1st Star (2 MSB)	2	11-10	U
-AST Hor. Coord. of 1st Star (2 MSB)	2	9-8	U
-AST Vertical Coord. of 2nd Star (2 MSB)	2	7-6	U
-AST Hor. Coord. of 2nd Star (2 MSB)	2	5-4	U
-AST Vertical Coord. of 3rd Star (2 MSB)	2	3-2	U
-AST Hor. Coord. of 3rd Star (2 MSB)	2	1-0	U
Calibrate Mode Y	16	0	U
Calibrate Mode Z	16	0	U

Data deposited in SPSSER

FIGURE A-24: ECIO SERIAL DATA

TYPE	DESCRIPTION
b	bit test
i	integer
j	subinteger
h	hex
v	voltage

LOGIC

```
b - IF (DATA .and. MASK) = 1
      then bit is off
      else bit is on

i   DATA = integer

J   rjs (DATA .and. MASK)

h   hexadecimal integer

v   voltage = 20/255(DATA+.5)*100
```

FIGURE A-25: DISPLAY TYPES

NO.	ELEMENT
1	HTRS xxx
2	IMCE PWR xxx
3	IMCE LOAD*
4	SELF TEST xxx
5	DRIRU PWR xxx
6	xxx
7	xxx
8	AST PWR xxx
9	AST TEMP +xxx
16	STBY*
17	OPER*
18	DRIRU*
19	CMT TRK*
20	CAL*
21	AST*
22	DEP*
23	PCC*
24	STRT xxxx
25	LNGH xxxx
30	IMCE TEMP +xxx
26	EXEC*
31	DRIRU TEMP +xxx
32	+xxx
33	+xxx
35	MAG CORD +x
36	+xxx
37	+xxx
38	+x
39	+xxx
40	+xxx
41	+x
42	+xxx
43	+xxx
44	AST STBY*
45	SRCH*
46	TRK*
47	FILTER SETTLED*
48	STRT ---- XXXX
49	MIRROR RESET*

FIGURE A-26: IMCS CREW PAGE DISPLAY ELEMENTS

NO.	TYPE	LN	SOURCE	DISPLAY		sid
0	v	4	KAI (27)			3279
1	b	3	ECASD1 x8000	INH	ENA	
2	b	3	SPSDIS x0002	OFF	ON	
3	b	1	ECASD1 x4000		*	
4	b	5	SPSDIS x2000	NOGO	GO	
5	v	4	KAI (11)			3263
6	v	4	KAI (12)			3264
7	v	4	KAI (13)			3265
8	v	4	KAI (22)			3274
9	v	4	KAI (17)			3269
16	b	1	SPSDIS x0800		*	
17	b	1	SPSDIS x0400		*	
18	b	1	SPSDIS x0020		*	
19	b	1	SPSDIS x0080		*	
20	b	1	SPSDIS x0040		*	
21	b	1	ECASD1 x0004		*	
22	b	1	ECASD1 x0002		*	
23	b	1	ECASD1 x0001		*	
24	h	4	DUMPB			
25	h	4	DUMPE			
26	b	1	SPSDIS x0008		*	
31	v	4	KAI (8)			3253
32	v	4	KAI (9)			3254
33	v	4	KAI (10)			3256
35	j	2	SPSSER(6) x7C00			3286
36	i	4	ECASI1			
37	i	4	ECASI2			
38	j	2	SPSSER(6) x03E0			3287
39	i	4	ECASI3			
40	i	4	ECASI4			
41	j	2	SPSSER(6) x001F			3288
42	i	4	ECASI5			
43	i	4	ECASI6			
44	b	1	SPSDIS x0020		*	
45	b	1	SPSDIS x0010		*	
46	b	1	SPSDIS x0008		*	
47	b	1	SPSDIS x0004		*	
48	h	4	DUMPC			

FIGURE A-27: FLIGHT CREW PAGE

INDEX	UPPER	LOWER	CONVERSION
1	+8.00	-8.00	A0=0.0, A1=.01955034
2	+8.00	-8.00	
3	+0.111	-0.111	A0=0.0, A1=.000325839
4	+0.111	-0.111	
5	+0.111	-0.111	
6	+0.111	-0.111	
7	+0.111	-0.111	
8	+0.111	-0.111	
9	+65.00	-9.71	A0=105.87402, A1=-1.203126
10	+65.00	-9.71	A2=7.104376E-3, A3=-2.371302E-5
11	+65.00	-9.71	A4=2.393933E-8, A5=-.433526
12	+70.0	28.0	A0=0.0, A1=.07963479
13	+70.0	28.0	
14	+70.0	28.0	
15	-47.0	-67.0	A0=-55.0, A1=.029326
16	+45.0	+15.0	A0=+6.0, A1=.097752
17	30.0	10.0	A0=14.0, A1=.048876
18	50.0	-10.0	A0=15.0, A1=.097752
19	7.0	4.5	A0=5.75, A1=.004301
20	0.0	-10.0	A0=-0.0, A1=.027370
21	0.0	-10.0	
22	0.0	-10.0	
23	5.25	4.75	A0=0.0, A1=.011144
24	30.0	10.0	A0=15.0, A1=.097752
25	10.0	7.5	A0=0.0, A1=.021505
26	20.5	17.5	A0=0.0, A1=.043011
27	-20.5	-17.5	
28	+80.00	-20.00	A0=-20.0, A1=.391007
29	+5.25	-4.75	A0=0.0, A1=.02346745
30	-15.75	-14.25	A0=0.0, A1=.07820137
31	+15.75	+14.25	A0=0.0, A1=.07820137
32	50.0	-10.0	A0=-.39100684, A1=+.39100684
33	+8.00	-8.00	A0=-5.12, A1=.04015686
34	+8.00	-8.00	
35	+8.00	-8.00	
36	+8.00	-8.00	
37	+8.00	-8.00	

*S( ) = SPSME Analog Input
A( ) = RAU Flexible Input

FIGURE A-28: EXCEPTION MONITOR

ITEM	FUNCTION	ACTION
1	HTRS ENA	Issue DOP - IMCE Heater On SID=#3370,DOP=11,SEID=58 Issue DOP - AST EA Heater On SID=#3374,DOP=15,SEID=62 Issue DOP - AST SA Heater On SID=3386,DOP=27,SEID=32
2	IMCE PWR ON	Issue DOP - IMCE Power On SID=#3368,DOP=9,SEID=56
3	IMCE LOAD	DEP Protocol MMU Load
4	SELF TEST	Issue SPSME DO 31 SID=#3902,WRI=001F,SDO=31
5	DRIRU PWR ON	Issue DOP - DRIRU A Power On SID=#3360,DOP=1,SEID=48 Issue DOP - DRIRU B Power On SID=#3362,DOP=3,SEID=50 Issue DOP - DRIRU C Power On SID=#3364,DOP=5,SEID=52
6	AST PWR ON	Issue DOP - AST Power On SID=#3372,DOP=13,SEID=60
7	AST PWR OFF	Issue DOP - AST Power Off SID=#3373,DOP=14,SEID=61
8	DRIRU PWR OFF	Issue DOP - DRIRU X Power Off SID=#3361,DOP=2,SEID=49 Issue DOP - DRIRU Y Power Off SID=#3363,DOP=4,SEID=51 Issue DOP - DRIRU Z Power Off SID=#3365,DOP=6,SEID=53
9	IMCE PWR OFF	Issue DOP - IMCE Power Off SID=#3369,DOP=10,SEID=57

FIGURE A-29: ITEM ENTRIES

ITEM	FUNCTION	ACTION
10	HTRS INHIBIT	Issue DOP - IMCE Heater Off SID=#3371,DOP=12,SEID=59 Issue DOP - AST EA Heater Off SID=#3375,DOP=16,SEID=63 Issue DOP - AST SA Heater Off SID=3387,DOP=28,SEID=33
11	STBY	Issue SPSME DO - Standby SID=#3903,WRI=0001,SDO=1
12	OPER	Issue SPSME DO - Operate SID=#3904,WRI=0002,SDO=2
13	DRIRU	Issue SPSME DO - DRIRU Only SID=#3905,WRI=0003,SDO=3
14	CMTRK	Issue SPSME DO - Comet Track SID=#3909,WRI=0007,SDO=7
15	CAL	Issue SPSME DO - Calibrate SID=#3911,WRI=0009,SDO=9
16	AST DUMP	
17	DEP DUMP	
18	PCC DUMP	
19	START	Data=start address
20	LNGH	Data=length
21	EXEC	Issue Dump Serial Message SID=TBD,WRI=F00x,ssss,1111
22	MIRROR RST	Issue SPSME DO - Mirror Reset SID=3938,WRI=0030,SEID=48

FIGURE A-29: ITEM ENTRIES
(CONTINUED)

:CMD: ISS-sid :ENTER:

SID	COMMAND	SDO	WRI
3907	DRIRU High/Low	5	0005
3908	AST SYNCH 1HZ	6	0006
3910	AST SYNCH 2HZ	8	0008
3912	AST SYNCH 3HZ	10	000A
3915	AST SYNCH 4HZ	12	000C
3916	REBOOT	11	000B
3917	GYRO CHNL XA,YB,ZA	13	000D
3918	XA,YB,ZC	14	000E
3919	XA,YC,ZA	16	0010
3920	XA,YC,ZC	17	0011
3921	XB,YB,ZA	18	0012
3922	XB,YB,ZC	19	0013
3923	XB,YC,ZA	20	0014
3924	XB,YC,ZC	21	0015
3925	AST STANDBY	15	000F
3926	AST SEARCH	22	0016
3927	AST SEARCH LFOV	23	0017
3928	AST RESET DEFECTS	24	0018
3929	AST LED ON	25	0019
3930	AST LED OFF	26	001A
3931	AST LIGHT FLOOD ON	27	001B
3932	AST LIGHT FLOOD OFF	28	001C
3933	AST FRAME START	29	001D
3934	SET GMT	30	001E
3902	SELF TEST	31	001F
TBD	DRIRU CHANNEL A HIGH	32	0020
TBD	A LOW	33	0021
TBD	B HIGH	34	0022
TBD	B LOW	35	0023
TBD	C HIGH	36	0024
TBD	C LOW	37	0025
3903	STANDBY	1	0001
3904	OPERATE	2	0002
3905	DRIRU ONLY	3	0003
3909	COMET TRACK	7	0007
3911	CALIBRATE	9	0009
TBD	Mirror Reset	48	0030

FIGURE A-30: GENERALIZED COMMAND (NO DATA)

:CMD: WRI-sid-F00x-dddd :ENTER:

SID	COMMAND	WRI
TBD	SET AST DEFECTS	F000 F002 dddd
TBD	AST TEST COMMAND	F000 F003 dddd dddd
TBD	DUMP AST	F000 F004 dddd
TBD	DUMP DEP	F000 F005 dddd dddd
TBD	DUMP PCC	F000 F006 dddd
TBD	AST UPDATE INTERVAL	F000 F007 dddd

FIGURE A-31: GENERALIZED COMMAND (DATA)

SID	COMMAND	WRI
TBD	GMT	F001 dddd dddd dddd dddd
TBD	COMET TRACK	F000 F008 dddd dddd dddd dddd dddd dddd dddd

FIGURE A-32: RAU SYNCHRONOUS SERIAL

SEID -DO	FUNCTION
0	Master Clock Status
32	AST SA Heater On
33	Off
34	Temp CAL Input
48	DRIRU A Power On
49	A Off
50	B On
51	B Off
52	C On
53	C Off
54	DRIRU Heater Power On
55	Off
56	IMCE Power On
57	Off
58	IMCE Heater On
59	Off
60	AST Power On
61	Off
62	AST EA Power On
63	Off

FIGURE A-33: SEID DISCRETE OUTPUTS

CYCLE	COMMAND	COMMENT
1	WRITE 1,GMT,1	Broadcast GMT
2	WRITE 0,GMT,1	Broadcast GMT
3	READ 0	Read PCM Channel 0
4	TIME	Read GMT & MET
6	SSEN-BLK 0,1,2,3,4,5,6,7	Read SPSME DI's
8	SSAM-BLK 0,1	Read SPSME AI's
10	SSREAD	Read SPSME Serial
50	PSAMPLE 0	Read RAU FI's
	PSAMPLE 2	
	PSAMPLE 4	
	PSAMPLE 6	
	PSAMPLE 8	
	PSAMPLE 10	
	PSAMPLE 12	
	PSAMPLE 14	
60	PSAMPLE 16	Read RAU FI's
	PSAMPLE 18	
	PSAMPLE 20	
	PSAMPLE 22	
	PSAMPLE 24	
	PSAMPLE 26	
	PSAMPLE 28	
	PSAMPLE 30	
70	PSAMPLE 32	Read RAU FI's
	PSAMPLE 34	
	PSAMPLE 36	
	PSAMPLE 38	
	PSAMPLE 40	
	PSAMPLE 42	
	PSAMPLE 44	
	PSAMPLE 46	
80	PSAMPLE 48	Read RAU FI's
	PSAMPLE 50	
	PSAMPLE 52	
	PSAMPLE 54	
	PSAMPLE 56	
	PSAMPLE 58	
	PSAMPLE 60	
	PSAMPLE 62	

The SEID GML is stored on the PDSS disk under filename 'RFC.MON'.

FIGURE A-34: PDSS/SEID GML

STATEMENT #	STATEMENT
1	IF D[0]<>0 THEN
2	LOOP D[0]
3	WAIT 0,10
4	END LOOP
5	DWRITE 0,9,1
6	ELSE
7	WAIT 10,0
8	ENDIF
9	START 5

NOTES:

1. The Comet Track sequence is stored on the PDSS disk under filename 'RFC.S5'.

2. The Comet Track seqeunce is loaded by PDSS and executed as sequence 5 in SEID ('DEF 5').

3. The Comet Track sequence executes continuously once started. Based on the value of SEID dynamic table entry 0 (D[0]), the sequence performs as follows:

D[0]	SEQUENCE
0	No I/O, Runs every 10 seconds
1	Writes Comet Track data every 10 milliseconds
10	Writes Comet Track data every 1 second

FIGURE A-35: COMET TRACK SEQUENCE DEFINITION

BRIGHTNESS		NEA	VARIANCE	VARIANCE
B ( )	1	0.68	0.4624	1.0868E-11
	2	0.46	0.2116	4.9735E-12
	3	0.29	0.0841	1.9767E-12
	4	0.22	0.0484	1.1376E-12
	5	0.17	0.0289	6.7928E-13
	6	0.14	0.0196	4.6069E-13
	7	0.12	0.0144	3.3846E-13
	8	0.11	0.0121	2.8440E-13
	9	0.10	0.0100	2.3504E-13
	10	0.10	0.0100	2.3504E-13
	11	0.09	0.0081	1.9039E-13
	12	0.09	0.0081	1.9039E-13
	13	0.08	0.0064	1.5043E-13
	14	0.08	0.0064	1.5043E-13
	15	0.07	0.0049	1.1517E-13
	16	0.07	0.0049	1.1517E-13
	17	0.07	0.0049	1.1517E-13
	18	0.06	0.0036	8.4616E-14
	19	0.06	0.0036	8.4616E-14
	20	0.06	0.0036	8.4616E-14
	21	0.06	0.0036	8.4616E-14
	22	0.06	0.0036	8.4616E-14
	23	0.05	0.0025	5.8761E-14
	24	0.05	0.0025	5.8761E-14
	25	0.05	0.0025	5.8761E-14
	26	0.05	0.0025	5.8761E-14
	27	0.05	0.0025	5.8761E-14
	28	0.05	0.0025	5.8761E-14
	29	0.05	0.0025	5.8761E-14
	30	0.05	0.0025	5.8761E-14
	31	0.05	0.0025	5.8761E-14
		(ARCSEC)	(ARCSEC**2)	(RADIAN**2)

FIGURE A-36: NEA LOOKUP TABLE

NOTES:

Given a star Brightness B(x), the Noise Equivalent Angle (NEA) and variance are computed from a table lookup.

Pixel Scale Factor

P2R = 24.51 Arcsec/pixel = 1.1882783E-4 Radians/pixel
(4.8481368E-5 Radians/arc-sec)

Boresight Coordinates

BSC = 239.6 (Column)
BSL = 290.1 (Line)

AST Validity Check Parameters

TOLB = 2 (Brightness Units)
TOLM = 2 (Motion Pixels)

C-2

FIGURE A-37: NEA LOOKUP TABLE NOTES

HEX	DEC	VOLTS	HEX	DEC	VOLTS
7F	127	9.96	80	-128	-10.04
73	11	9.02	8D	-115	-9.02
6C	108	8.47	94	-108	-8.47
66	102	8.00	9A	-102	-8.00
60	96	7.52	A0	-96	-7.52
59	89	6.98	A7	-89	-6.98
53	83	6.51	AD	-83	-6.51
4D	77	6.04	B3	-77	-6.04
46	70	5.49	BA	-70	-5.49
40	64	5.02	C0	-64	-5.02
39	57	4.47	C7	-57	-4.47
33	51	4.00	CD	-51	-4.00
2D	45	3.53	D3	-45	-3.53
26	38	2.98	DA	-38	-2.98
20	32	2.51	E0	-32	-2.51
1A	26	2.04	E6	-26	-2.04
13	19	1.45	ED	-19	-1.45
00	13	1.02	F3	-13	-1.02
06	6	0.47	FA	-6	-0.47
00	0	0.00			

ECIO: VOLTAGE RANGE = -10.0 TO +10.0
COUNT RANGE = -128 TO +127
CONVERSION FACTOR = .07843137

FIGURE A-38: ECIO VOLTAGE CONVERSION

HEX	DEC	VOLTS	HEX	DEC	VOLTS
1FF	511	9.99	200	-512	-10.00
1E6	486	9.50	21A	-486	-9.50
1CC	460	8.99	234	-460	-8.99
1B3	435	8.50	24D	-435	-8.50
180	384	7.51	280	-384	-7.51
166	358	7.00	29A	-358	-7.00
14C	332	6.49	2B4	-332	-6.49
133	307	6.00	2CD	-307	-6.00
119	281	5.49	2E7	-281	-5.49
100	256	5.00	300	-256	-5.00
0E6	230	4.50	31A	-230	-4.50
0CD	205	4.01	333	-205	-4.01
0B3	179	3.50	34D	-179	-3.50
099	153	2.99	367	-153	-2.99
080	128	2.50	380	-128	-2.50
066	102	1.99	39A	-102	-1.99
04D	77	1.51	3B3	-77	-1.51
033	51	1.00	3CD	-51	-1.00
01A	26	0.51	3E6	-26	-0.51
000	0	0.00			

HRM: VOLTAGE RANGE = -10.0 TO +10.0
COUNT RANGE = -512 TO +511
CONVERSION FACTOR = .01955034

FIGURE A-39: HRM VOLTAGE CONVERSION

HEX	DEC	VOLTS	HEX	DEC	VOLTS
7FF	2047	10.0	F801	-2047	-10.00
799	1945	9.50	F867	-1945	- 9.50
732	1842	9.00	F8CE	-1843	- 9.00
6CC	1740	8.50	F934	-1740	- 8.50
666	1638	8.00	F99A	-1638	- 8.00
5FF	1536	7.50	FA01	-1536	- 7.50
599	1433	7.00	FA67	-1433	- 7.00
532	1331	6.50	FACE	-1331	- 6.50
4CC	1229	6.00	FB34	-1229	- 6.00
466	1126	5.50	FB9A	-1126	- 5.50
3FF	1024	5.00	FC01	-1024	- 5.00
399	921	4.50	FC67	- 921	- 4.50
333	819	4.00	FCC0	- 819	- 4.00
2CC	717	3.50	FD34	- 717	- 3.50
266	614	3.00	FD9A	- 614	- 3.00
1FF	512	2.50	FE01	- 512	- 2.50
199	410	2.00	FE67	- 410	- 2.00
133	307	1.50	FECD	- 307	- 1.50
CC	205	1.00	FF34	- 205	- 1.00
66	102	0.50	FF9A	- 102	- 0.50
0	0	0.00			

CAMAC-AO VOLTAGE RANGE = -10.00 TO +10.00
COUNT RANGE = -2048 TO +2047
CONVERSION FACTOR = 0.004884

FIGURE A-40: CAMAC-AO VOLTAGE CONVERSION

Flight Command Format

Word 1: | Command Code | Word 2: | Command Parameters |

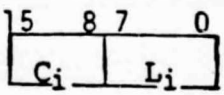
COMMAND TABLE

COMMAND	COMMAND CODE (HEX)	COMMAND PARAMETER
Standby	F000	None - Note 1
Frame Search (limited FOV)	F002	None
Frame Search (full FOV)	F003	None
Add Defect Coordinates	F004	Note 2
Reset Defect Map	F005	None
Specify Update Interval	F001	Note 3
Memory Dump	F020	Note 4
Self Test LED On	F040	None
Self Test LED Off	F041	None
Light Flood On	F008	None
Light Flood Off	F009	None
Frame Start	F080	None

Notes:

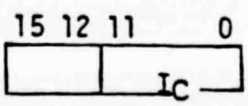
1. When additional parameters are not required for a command, the second word of the fixed 2 word format is ignored by ASTROS.

2. This command adds a 6x6 pixel region to the CCD defect map. The Command Parameter is defined as follows:



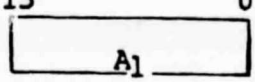
Where C_i, L_i identify the 6x6 pixel region as containing the corners $(2C_i-2, 2L_i-2)$ and $(2C_i + 3, 2L_i + 3)$, and $2 \leq C_i \leq 158$, $2 \leq L_i \leq 254$

3. Word #2 has the format



Where: I_C is the ASTROS Update Interval (in milliseconds)

4. Word #2 has the format



Where: A_1 is the 16-bit address of the first word of memory to be read.

FIGURE A-41: FLIGHT COMMAND FORMAT

Word 1: [Command Code] Word 2: [Command Parameter]

Command	Command Code ASCII	Command Code HEX	Command Parameter
1. Load Line Window 1	"L1"	4C31	Note 1
2. Load Column Window 1	"P1"	5031	Note 1
3. Load Line Window 2	"L2"	4C32	Note 1
4. Load Column Window 2	"P2"	5032	Note 1
5. Load Line Window 3	"L3"	4C33	Note 1
6. Load Column Window 3	"P3"	5033	Note 1
7. Window Exposure	"WX"	5758	Note 2
8. Dump Window Data	"WD"	5744	Note 3
9. Load Threshold Value	"LT"	4C54	Note 4
10. Threshold Exposure	"TX"	5458	Note 2
11. Dump No. Thresold Pixels	"NT"	4E54	None - Note 5
12. Dump Thresold Data	"TD"	5444	Note 6
13. Map Exposure	"MX"	4D58	Note 2
14. Software Reset	"SR"	5352	None - Note 7
15. Memory Dump with Checksum	"MD"	4D44	Note 8
16. Local Status	"LS"	4C53	None - Note 9
17. Dump CCD Parameters	"CP"	4350	None - Note 10
18. Load Radiator DAC	"RD"	5244	Note 11
19. Load Optics DAC	"OD"	4F44	Note 11
20. Load CCD (TEC)	"CD"	4344	Note 11

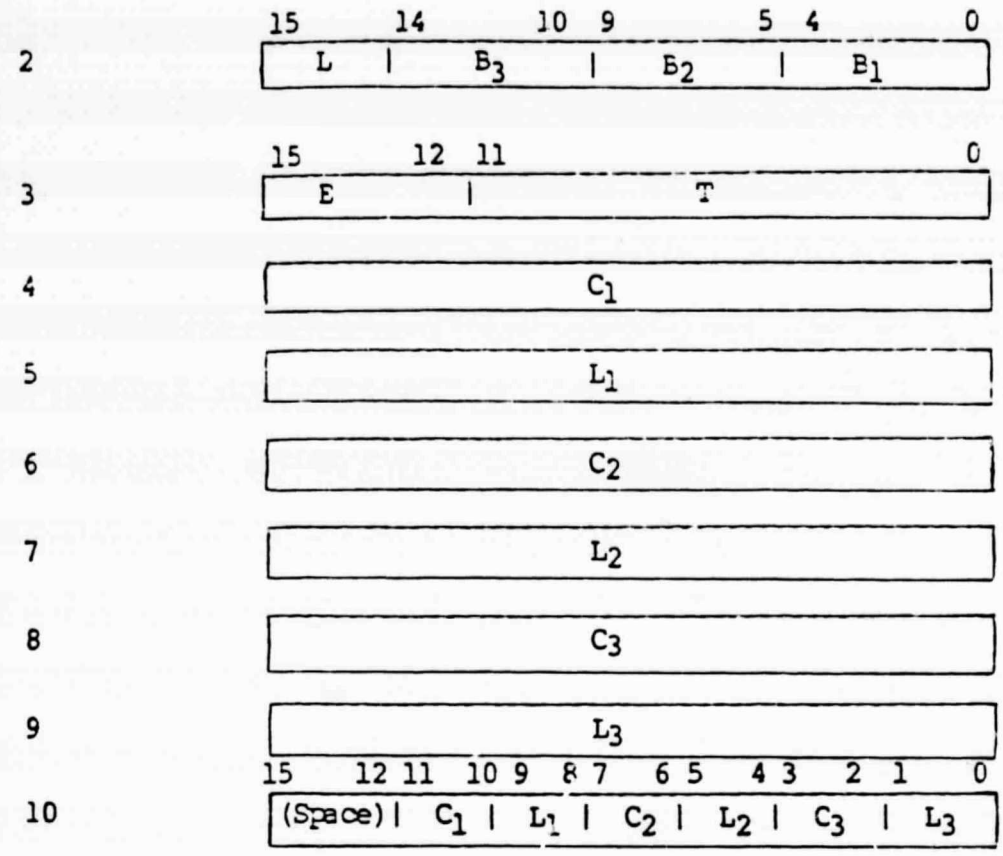
Notes:

1. The line and column of a 5x5 window are the coordinates of the window pixel nearest (0,0).

2. The exposure (integration) time is in units of 0.1ms. All 6 window coordinates must be preloaded with valid values before this command is issued. For each line in a window, the 3 column guard band pixels are input and stored in addition to the 5 line pixels in the window. (8 pixels/line x 15 lines = 120 total data numbers stored). All pixel data numbers are stored sequentially without sorting.

FIGURE A-42: TEST COMMAND FORMAT

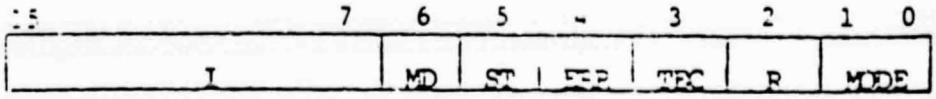
Word #



Abbreviation	Title	Possible Values
B_i	Brightness of ith star	= 0 = invalid star, otherwise $= \frac{\sum (\text{pixel intensity} - \text{threshold})}{\text{Scaling factor}}$
L	Light flood status	0-OFF 1-ON
E	Error Number	0-15
T	Integration time	= T (in milliseconds)

FIGURE A-43: STATUS WORD FORMAT

Status Word = First word of each data output:



Abbreviations	Title	Possible Values:
Mode	Operating Mode	0-Full Field Acquisition 1-Limited Field Acquisition 2-Track 3-Standby
R	Rate Flag	0-Normal Operation 1-Requested update interval will degrade performance
TEC	Thermoelectric Coder Power	0-OFF 1-ON
ERR	Error Flag	0-Normal Operation 1-Error State
ST	Self-Test Star	0-OFF 1-ON
MD	Memory Data	0-Normal Operation 1-Subsequent 9 words are memory data
I	Approximate Interval between updates	= I x 10ms

FIGURE A-44: ACQUISITION MODES AND TRACK MODE DATA FORMAT

(or exposure time)

Abbreviation	Title	Possible Values
C_i, L_i (Words 4-9)	Coordinates of ith star	16 LSBs of the vertical and horizontal coordinates of the ith star relative to the CCD frame corrected for optical distortion.
C_i, L_i (Word 10)	MSBs of ith star	Two MSBs (bits 16 and 17) of the vertical and horizontal coordinates of the ith star position.

FIGURE A-44: ACQUISITION MODES AND TRACK MODE DATA FORMAT (CONTINUED)